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SPILLOVER OF PUBLIC EDUCATION COSTS AND BENEFITS. PART 2--COSTS (TITLE SUPPLIED).

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THIS STUDY DEVELOPED AN INTEGRATED FRAMEWORK FOR THE ANALYSIS OF SPATIAL SPILLOVERS, HAND-IN-HAND WITH A SYSTEMATIC APPROACH TO THE CONCEPTS OF COSTS AND BENEFITS ARISING FROM PUBLIC SUPPORT OF PRIMARY AND SECONDARY EDUCATION. EMPHASIS WAS ON WAYS IN WHICH SPILLOVERS MAY AFFECT LOCAL DECISION-MAKING. ABSTRACT CONCEPTS WERE DEVELOPED AND APPLIED TO THE CLAYTON, MISSOURI, SCHOOL DISTRICT. ANALYSIS WAS MADE OF THE COMMUNITY COST SPILLOVERS OF THE SCHOOL DISTRICT WITH A GENERAL FRAMEWORK BEING DEVELOPED FOR COST SPILLOVER ANALYSIS. EACH OF THE SPILLOVERS OF COMMUNITY COST IS DISCUSSED IN DETAIL AND ANALYZED IN RELATION TO (1) LOCAL FINANCING THROUGH PROPERTY TAXATION, (2) FINANCING THROUGH STATE PERSONAL INCOME TAXES, AND (3) FINANCING THROUGH RETAIL SALES AND EXCISE TAXES. METHODS WERE DEVELOPED AND DISCUSSED FOR ANALYSIS OF IMPUTED OPERATING COSTS AND CAPITAL COSTS. CASE STUDY FINDINGS WERE THEN INTEGRATED WITH INTERCOMMUNITY COST SPILLOVER. THE LATTER PART OF THE STUDY DISCUSSED THE BENEFICIAL SIDE TO EDUCATION. SPECIFICALLY IDENTIFIED WERE THE MAJOR BENEFITS AND KEY CONCEPTS IN RELATION TO SPATIAL SPILLOVER MECHANISMS, SUCH AS MIGRATION AND FISCAL INTERDEPENDENCE. ALSO, BENEFIT SPILLOVERS WERE DISCUSSED IN THE FORM OF STUDENTS' INCREMENTAL EARNINGS AND OF THE CHILDCARE VALUE OF PUBLIC EDUCATION. A FRAMEWORK WAS DEVELOPED WITHIN WHICH INTERCOMMUNITY COST AND BENEFIT SPILLOVER ANALYSIS CAN BE CARRIED OUT IN AN INTEGRATED MANNER. FINALLY, THE INVESTIGATORS EXAMINED SOME OF THE POLICY IMPLICATIONS OF THE ANALYSIS FOR LOCAL, STATE, AND FEDERAL GOVERNMENTS. (HD)

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INSTITUTE OF GOVERNMENT AND PUBLIC AFFAIRS

SPILLOVER OF PUBLIC EDUCATION COSTS AND BENEFITS

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INSTITUTE OF GOVERNMENT AND PUBLIC AFFAIRS

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PREFACE

Education has long been an important aspect of American life. Only in recent years, however, have economists begun to apply their analytical tools to the study of its effects. This study was undertaken in recognition of the fact that education is both costly and beneficial to people outside the school district in which education is provided. Numerous widespread spillovers of education's costs and benefits have a significant bearing upon how efficiently our school systems work and how equitably they are financed. In a desire to enrich the public discussion of these issues, this study attempts to develop an integrated framework for the analysis of spatial spillovers, *hand in hand with a* systematic approach to the concepts of costs and benefits arising from public primary and secondary education. Our emphasis throughout is upon ways in which these spillovers may affect local decision making. We do not stop with the development of abstract concepts, but attempt to apply them to a particularly interesting school district. This makes it possible to evaluate the efficacy of various proposals in the light of early empirical implementation.

The reader must remember that the analysis of a service as complex and diversified as education permits only uncertain estimates. Nevertheless, while the study addresses itself to external cost and benefits of primary and secondary public education, it is hoped that many of the questions raised, the concepts developed, and the model built (and partially implemented) will prove suggestive and helpful to the study of other parts of the public sector. There should, for example, be little difficulty in applying and extending the analysis to higher education, and even such public services as fire and police protection, transportation, and health and welfare services might be analyzed to advantage in a similar way.

This study is divided into four parts. The introductory section, Chapter I, sketches out the main issues of the investigation. Part II analyzes key intercommunity cost spillovers. Chapter II develops a general framework for cost spillover analysis. The intercommunity spillovers of operating costs are considered in Chapters III, IV and V, which analyze local financing through property taxation, financing through state personal income taxes, and financing through retail sales and excise taxes, respectively. In Chapter VI methods are developed for the analysis of imputed operating costs; capital costs are discussed in Chapter VII. Intercommunity cost spillover analysis is integrated and summarized in Chapter VIII with the aid of the case study findings.

The third part turns to the benefit side of public education. Chapter IX identifies some of the major benefits and key concepts in relation to the spatial spillover mechanisms: migration and fiscal interdependence. Benefit spillovers in the form of students' incremental earnings and of the childcare value of public education are investigated in Chapters X and XI. Following an analysis of these two direct education benefits, Chapter XII inquires into four indirect benefits and their spillovers. In Chapter XIII the benefit analysis is summarized and integrated with the aid of the case study.

The final part is composed of two chapters: Chapter XIV develops a framework within which intercommunity cost and benefit spillover analysis can be carried out in an integrated manner and applied to the case study; Chapter XV examines some of the policy implications of the analysis for local, state, and federal governments.

This study was carried out over a period of three years. It was initiated jointly with Burton A. Weisbrod at Washington University, St. Louis. After the first year, during which the research benefited greatly from discussions with Burton A. Weisbrod and William J. Swift, these two investigators left Washington University and went east. Their effort culminated in the publication, External Benefits of Public Education: An Economic Analysis (Princeton: Princeton University, 1964). Somewhat later Elbert W. Segelhorst, Morton J. Marcus and I moved west—an excellent example of the mobility factor in education.

The entire study was made possible by support from the Cooperative Research Program, United States Office of Education, which proved to be a thoughtful and sophisticated sponsor. We are grateful to Dr. Francis A. J. Ianni and Dr. Alice Y. Scates of the Office of Education for their interest and assistance.

Our investigation was facilitated by the excellent assistance and cooperation of the Clayton School District, Clayton, Missouri. Superintendent Francis V. Lloyd and Assistant Superintendent George M. Stuber generously secured data for us and patiently endured our frequent inquiries.

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Stanley M. Berman served two years as a research assistant on this study at Washington University during which time he made significant contributions to Chapters III, V and IX;his intensive statistical efforts are reflected in the Appendix. A special expression of gratitude is due Anthony Oberschall who offered substantive technical advice as our computer interlocutor for migration matrices.

The overall editing and physical production of this report were in the able hands of Mrs. Elaine Linden and Mrs. Lyda Boyer of the Institute staff. Early typing and preliminary editing were carried out at Washington University by Mrs. Helen Ryan and Mrs. Fay Landau. The final manuscript was ably prepared by Mrs. Nancy Anderton of the Institute staff.

Grateful appreciation is expressed to all those who aided in the study, although clearly the responsibility for any errors of omission or commission rests with the authors.

WZH

Los Angeles, California
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PART I

Chapter I

INTRODUCTION

Scope and Issues

Primary and secondary public education is provided in the United States within a federated political structure in such a way that the smallest relevant unit, the local school district, makes the most important decisions. This political structure for providing public education was generally formulated over a century ago—when our present complex and highly interdependent industrial economy was only beginning to emerge. In those days of physical isolation, individualism, and self-determination, each community raised funds to finance its services, and virtually all cost burdens and benefits stayed within its boundaries. However, in a modern nation, which enjoys a federated political and fiscal system and is distinguished by great specialization of economic activity—and therefore economic interdependence—by rapid mobility, and by advanced industrialization and urbanization, urban government decisions become much more complex. Rational decisions, carefully made, can, because of intercommunity spillovers, be inconsistent not only with the district's long-run interests but particularly with national goals.

Within the context of today's industrial economy, people, as well as their commercial activities and products, continuously cross political boundaries so that a wide diffusion of effects can be expected from a governmental decision with respect to public education. These effects will be felt in varying degrees in other school districts. More specifically, parts of both the costs and benefits generated by the provision of public education in a particular local school district will ultimately be realized by individuals elsewhere. This occurs, for example, as the cost of education is shifted outside the school district's political boundary, by including part of the cost in the prices of goods and services its residents produce and "export." The benefits of education are shifted out of the district by the migration of the individuals who initially received education in the district and because of fiscal interdependence.

What are some of the costs of, and benefits from, public primary and secondary education; how are they spilled in and out of a particular school district; on whom does the burden fall and who are the beneficiaries, i.e., people within the district or outside it; and how large are the burdens and benefits and their spillovers? These are some of the questions considered in this volume, for which an integrated benefit-burden framework is advanced and applied to a case study.

At the outset, let us state that if any portion of the costs or benefits resulting from public education provided in one school district is ultimately realized by residents of another, we speak of intercommunity cost or benefit spillover. The flow can move in both directions—into the district and out of it. In the first case we have spillins, and in the second, spillouts.

Let us look at some of the cost and benefit components of public education, keeping in mind that, except for the consumption aspects, education benefits differ from costs in their time horizon. While most costs are incurred during the year in which education is provided, few of the benefits are realized at that time. Rather, education benefits exhibit a similarity to capital assets in their long-run nature. Some of the benefits of educational capital become difficult to isolate and measure when they blend into the social fabric, forming an integral part of the culture of society. To the extent that education benefits are measurable, a lifetime investment approach is taken, discounting the stream of future benefits back to the year for which the cost analysis is made. This technique provides comparability in that costs associated with the education provided during a single year—the budgetary period for school district expenditure decisions—can be examined and compared with benefits related to the same period.

A basic analytical tool used in this study is the annual benefit-burden statement of a school district. It is composed of two columns—cost burdens and benefits for a given year. The entries represent not only the burdens and benefits realized by residents of a given school district from the education it provides and finances but also those benefits or burdens that the district realizes as a result of education provided throughout the country.

Cost entries represent the values in alternative employment of resources allocated to education. Some are direct, i.e., they appear with specific reference to education in the accounting statements of public or private units; other costs are imputed. Of the imputed costs, which can involve operating or capital resources, some are financed out of taxes and others are not. Among the more interesting imputed operating costs that are not tax financed are the earnings foregone by students while they attend school, and various expenses incurred by students and parents while the former receive their education. Imputed operating costs financed by taxes include annual interest on direct operating costs and services rendered by municipalities. All these, together with the largest single cost item, the direct operating costs associated with teaching and non-teaching manpower and materials, constitute the overall cost of operating resources.

There are four major capital costs: annual principal repayment and annual interest on outstanding debt are direct costs; and the excess of annual capital consumption over annual principal repayment, together with interest on school district equity, constitute the imputed portion of the costs.

Turning next to the benefit side, we consider total or social benefits of education, in economic welfare terminology, as the outward extension of the utility possibility function of society, just as costs are defined as a contraction of that function.[1] The difference between total benefits and costs is the net benefit (or cost) to society associated with reference to a particular education decision.

What are the major forces that can push outward the utility possibility function? First, there are those aspects of education which increase production potential, such as improved skills and capabilities of students, and those which make possible the reallocation—total or partial—of resources. For example, it appears that the presence of educated individuals in a community can reduce the need for such services as law enforcement, fire protection and public health, and as a result resources are freed for other uses. However, to the extent that education merely alters relative prices without affecting total utility opportunities for a particular group, it is omitted from the list of social benefits (or costs).

While we are concerned with benefits that occur within the market, some do lie outside it. Those that occur outside the market, as, for example, the long- and short-run satisfactions gained by parents and students from the latter being exposed to new ideas and culture (consumption benefits) and the long-run special contributions that educated persons make to civic and charitable causes, are most difficult to measure. Such aspects are excluded from our study in order that the benefit concept be consistent with the opportunity cost concept, which covers only resources used for education that have an alternative market value.

As mentioned earlier, most education benefits add to long-run satisfaction. These capital resource benefits include the incremental productivity and earnings of students (and their families) attributable to education. Furthermore, there are some short-run or current benefits which are direct in nature and which accrue to the student's family while he attends school. By their entrance into school, children no longer require the daytime attention of their mothers, who, as a consequence, are free to seek employment outside their homes. A partial increment in the output of society results as resources are reallocated.

In addition to these direct benefits to the student and his family, education benefits many other persons. Non-student families may receive indirect long-run benefits in the form of lower taxes or increased services or both. If the level of one's consumption of public services is independent of one's education and income, then the additional taxes generally paid by persons with more education and income tend to decrease tax burdens upon other taxpayers and/or offer them more services.

Other possible indirect benefits, partly financial and partly non-financial, will be mentioned briefly. Schooling can increase the productivity and income of the former student's co-workers; schooling may also benefit the student's future children, who will receive informal education in the home. Increased education may result in a decline in service needs through a reduction of police, judicial, and other costs of crime, as well as welfare payments; neighborhood living conditions may improve by the application of positive social values developed in children by the schools; employers may be helped by having available a well-trained and skilled labor force; and society at large may be favorably affected by the fact that education furnishes the basis of an informed and literate electorate.

Now that we have identified cost and benefit elements of public education, we will examine the spillover mechanism. Public education cost spillovers result from both tax and expenditure decisions. The major costs find their way into the burden-benefit statement through an analysis of school district revenues. For each revenue source a separate analysis must be made because of different spatial tax incidence patterns. Analysis of these patterns helps to place the ultimate cost burden. The net amount of a district's resources apportioned to its public schools is determined by the level of local taxes, their spatial burden pattern, and the proportion of local tax revenue spent on public education provided within the local community. Together these factors determine the net balance between the ultimate resource cost or tax burden of a community and the amount of resources ultimately utilized for the provision of public education. The latter is the expenditure incidence. Within a local government decision framework, all costs, except those costs to parents and students that are not related to taxation, can spill in and spill out.

It is the school district where the beneficiary resides when an education decision is made that is the decisive factor in evaluating effects of cost and benefit spillovers. Insofar as benefits that come about within the market are concerned, disposable income, which accrues directly to students and their (present) families, does not spill over. This is true both for short- and long-run direct benefits. However, indirect benefits, disposable income and tax benefits which accrue to non-student households, can spill over. The reasons are two: migration and fiscal interdependence.

As an example of the working of migration and fiscal interdependence we may select the tax reduction for non-student families that results from the investment in education of the community's youth and the latter's subsequent additional income. Who benefits from these tax savings and how much depends both upon the migration that transfers educational capital from one district to another and upon a host of considerations that determine the ultimate burden of those taxes that would have fallen upon non-student households.

The tax burden considerations include the location of the taxpayers' residence and the geographic jurisdiction of the tax-levying unit. Tax savings of non-student families are likely to be realized at all levels of government. To the extent that the additional taxes paid by people with more education exceed the marginal cost of any additional public services they consume because of their additional education, and therefore income, some of the benefits of education are thereby transferred to other people within the fiscal units. As a result of education, all non-student families in the country benefit from additional taxes paid to the federal government; all non-student families in the state benefit from additional payments to the state; and all non-student families in the school district benefit from additional taxes paid to the local government. In short, existing fiscal arrangements are such that part of the benefits appear as tax savings in other districts, i.e., they lead to a sharing of benefits with residents of other districts.

Further benefit sharing comes about because students migrate. Thus, as educational capital moves from one district to another, tax savings are transferred with it. The loss of future tax base, and consequently tax rate reduction, as a result of student out-migration, is a benefit spillout, not a cost of providing local education.

A few words remain to be said about some of the other benefit elements. Within a local government decision framework, benefits resulting from incremental productivity and net private earnings of students and of mothers for whom schools provide custodial childcare will not spill over. On the other hand, benefits in the form of declining service needs for protection and social and welfare services readily spill over, if only because of fiscal interdependence.

Two key fiscal objectives should be kept in view in this analysis. These are fiscal progressivity and resource allocation efficiency. Fiscal progressivity requires that some appropropriate relationship be established between those who receive services and benefits and those who ultimately pay for them, specifically that the benefit-cost ratio varies inversely with income.

Maximizing resource allocation efficiency means that marginal social benefits should coincide approximately with marginal social costs. But social or national benefits (or costs) do not always coincide with community benefits (or costs). If that happens, the district will behave in a socially non-optimum manner. Specifically, the district will tend to underinvest if its ratio of marginal benefits to marginal costs is less than the corresponding ratio anticipated for the nation as a whole from expenditure in the district. Likewise, when the district's ratio of marginal benefits to costs exceeds that of the nation there is a tendency to overinvestment. Such discrepancies can result from either intercommunity cost or benefit spillovers, or both types of spillovers at disparate rates.

Some Concepts and Models

Let us now turn to a discussion of a relevant time period, then of the spatial or geographic unit, for the analysis of cost and benefit spillovers. A single year appears to be the most relevant period during which public education decisions are made.[2] Although many of the actions taken by local school boards, and by state and federal legislatures, tend to be guided by, and related to, previous decisions, each session offers an opportunity for a different policy, expenditure level, or tax measure. Similarly, school district elections authorizing tax levies are related to previous decisions and obligations, but the voting process "serves to insure that competing alternatives may be experimentally and provisionally adopted, tested and replaced by new compromise alternatives."[3]

The concept of the community is elusive, but very important. The school district is the fundamental political unit charged with the responsibility of providing education.[4] But a discussion of costs and benefits does not imply accruals to an abstract entity, a fictional geographic configuration arising from historical accidents and exigencies. Rather, benefits and cost burdens are realized by individuals or family units; the problem investigators face is the selection of a meaningful aggregation of individuals. Among the logical possibilities of such aggregations, two seem most promising.

One approach looks upon a district as an aggregate of persons with legal residency in a given political unit at a given period of time, i.e., when the expenditure decision is made. If an individual moves from one area to another he would be considered, in this view, a resident of the district in which he lived during the selected time period. Thus, for example, if 1964 is the year for which the benefit-burden statement is being constructed, all persons will be regarded as residents of the district in which they (or their parents) lived in the year 1964, regardless of where they will live in future periods and where they lived in the past. This may be termed a current population construction of the district's benefit-cost burden statement. It will be referred to as the local construction or model since it finds all persons associated with a district's statement in one locality at a given point in time. The local model considers changes in the wealth of a set of individuals currently identified by location without regard to their future locations.

Contrasted with this approach is a second construction in which the benefits or cost burdens realized by persons while resident in the district are aggregated to provide the entries in the district's statement. This view offers, in present value form, an indication of the expected inflow and outflow from the wealth of the district as the result of education provided by the given area and other areas as well. This changing population construction is concerned with the area and the welfare of its residents over time. It will be referred to as the national model, since the component individual units may be anywhere in the nation at a given point in time and in the given district only at some time in the future.

We have chosen to use the local model as the definition of the community throughout this study. The citizen and his representatives have many motives and objectives for their decisions. They may seek to provide the best education for their own children or the children of the district in which they live as a matter of principle. They may seek to have their community known as a good place to raise children either out of local pride or concern with realty values. Nobility of spirit and sincere altruism as well as vainglorious and venal motives may be operating in the decision-making process when the voters or their representatives consider education. We have selected only one of the many possible motives of individual behavior: economic self-interest——the maximization of wealth, the capital value of future income streams.[5] Self-interest is presented in terms of the household unit; we assume that parents act on behalf of their children. Therefore, each person wants to know the present and future consequences of an action; he does not care where he or his family will be living when those consequences are realized. This is the basis for selecting the local model.

The local model is of concern to the elected decision maker. If a homogeneity of interests is assumed in the district, and this is not a necessary assumption, the local model's findings will tell the official whether or not a proposal is to the advantage or disadvantage of his constituents' interests. As long as it is assumed that voters cast their ballots in line with their interests, it behooves the representative to act in accordance with those interests if he wishes to remain in public office.[6] Uncertainty with respect to future migration might raise some questions concerning the utility of this model for the political office holder, but frequent elections and a basic stability in the community's composition may be assumed.

Finally, we should introduce the case study area: Clayton, Missouri. Clayton is adjacent to the city of St. Louis and in 1960 had a population of about 15,000; it is the seat of government of St. Louis County (the suburbs of St. Louis), a county with a 1960 population of about 704,000. The Clayton School District is coterminous with the city of Clayton, except that the District includes a small portion of the city of Richmond Heights.[7]

Clayton is an unusual community with many attributes likely to influence its position with respect to education spillovers. It is a major shopping and financial center for the population of St. Louis County and the western section of the city of St. Louis; its retail shops cater to the wealthiest clientele in the metropolitan area; retail sales in 1958 exceeded $75 million; it has many state and regional sales offices of national firms, as well as numerous medical facilities. All of these characteristics contribute to its property wealth and make possible its high level of public school expenditure of $833 per pupil in average daily attendance in 1959-1960, compared with the national average of $369.[8] Median family income in Clayton was $10,925 in 1959, 74 per cent higher than the median for the entire St. Louis County, $6,275.[9] The median number of years of schooling completed among its persons 25 years of age and older, 13.3, was the highest among the 15 municipalities of St. Louis

County having populations of 10,000 or more.[10] The comparable level for the United States was 10.6 years.[11] The large number of regional offices of national organizations that periodically transfer personnel contributed to what was probably an unusually high rate of population turnover, although this cannot be documented and although not all of the personnel were residents of Clayton.

It should be emphasized that Clayton is not presented as a typical or representative American community, although it may be reasonable representative of relatively high income suburban communities, at least with respect to spillovers of education benefits. As we describe the methods of computing benefit spillovers for Clayton it should become evident how results would vary if a community or region with other characteristics were under consideration.

Prior to the choice of Clayton, the decision had been made to study a community within a metropolitan area rather than one which was more physically and economically isolated and which would therefore probably have fewer spillovers. Clayton was chosen primarily because of its proximity to St. Louis, which facilitated data gathering. However, when data were inadequate, the best available estimates and approximations were made.

This brings us to a more general point which cannot be emphasized enough. Any benefit-cost analysis of education is undertaken in a context of uncertainties. These are particularly great when spatial spillovers are investigated.

Benefits and capital costs have a long time-horizon and many unforseen changes in fundamental conditions can take place. The interrelations are numerous and highly complex and, at the moment, quantifiable only to a minor extent. Because of these considerations, the reader should remember that all findings of this study are based on stringent assumptions—hopefully, most of which have been explicitly stated—as well as partial information, often of doubtful quality.

However, the research strategy outlined in this volume does not call for empirical findings directly applicable to the case study. Instead, the case study is designed merely to help test some of the theoretical concepts and models and improve upon them.

Our hope is that the following chapters will elucidate issues surrounding benefit-cost analysis of education and their spillovers. But not less importantly, we hope that the framework, models, and concepts advanced in this study will have more general application to the analysis of externalities in the public sector of our economy. Should this be the case, and others stimulated to take our initial ideas as points of departure for their work, we will be highly satisfied with our effort.

PART II

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Chapter II

INTERCOMMUNITY COST SPILLOVER ANALYSIS

In selecting specific revenue sources and agreeing on what is to be financed out of taxes and what out of bond issues, those who make decisions for the financing of public schools affect intercommunity cost spillovers in a major way. In anticipation of such costs, revenue decisions need to be made. Intercommunity cost spillover analysis, therefore, best proceeds from an identification of costs and their magnitude to the measurement of expenditures and their corresponding revenues. Different taxes and revenue sources can be distinguished in terms of their spatial tax incidence patterns, and one of the main objectives of this study is to gain improved understanding about them. However, before this can be done, useful cost concepts need to be developed. This is the first task of this chapter and will be followed by a brief presentation of a general framework for cost spillover analysis.

Cost Concepts and Definitions

The generally accepted explanation of costs is contained in the alternative (or opportunity) cost theory. Stated in general terms, "The cost of productive service X in the production of A is equal to the largest value of the marginal product of X in its other possible uses (B, C, ...)."[1] Applying the opportunity cost theory to public education, we can state that the total or social cost of providing a given quality of public education is the product which could have been obtained by utilizing the services of productive resources in their most valuable alternative uses.

The cost of productive resources used in the provision of public education during a specified period can be divided into two categories — operating and capital costs. Resources that are entirely consumed during the accounting period can be said to involve operating costs; and services of such non-durable productive resources, as human services, fall into this category. On the other hand, resources that are only partly consumed during a given accounting period can be defined as involving capital costs. Such a definition is consistent with the position taken by Gary S. Becker in his statement, "The ideal depreciation on a capital asset during any period would equal its change in value during the period."[2]

Operating and capital costs can be further subdivided into direct and imputed costs. Direct costs involve overt money transactions to compensate for resources used and tend to show up in one form or another on a private or public balance sheet as accounting costs explicitly relating to education. Imputed or indirect costs are less obvious. They do not register on any private or public balance sheet as accounting costs directly relating to education.

The fact that certain education costs need to be imputed relates mainly to the institutional framework within which public education is provided. However, there can be no doubt that imputed costs are real social costs. Additional output or income could have been realized had those resources used to provide public education been devoted to production in the private, or in another public, sector of the economy.

Cost imputation also partly relates to the period of valuation. Within a local decision-making framework in which the community evaluates the expected change in its wealth position as a result of providing public education during a given accounting period, costs are assumed valued at the end of the period. Clearly, the community incurs an interest cost on all resources allocated for provision of education during the period — both operating and capital. However, if the rate of interest and discount were equal, and if all operating costs were incurred and valued at the beginning of the period, no cost imputation of foregone interest on the operating portion of resources would be required since the discounted present value of the imputed interest would be zero. The rate of interest and the rate of discount would mutually offset each other.

Most public education costs analyses tend to emphasize direct costs, particularly those financed by local school district tax revenue. Such imputed costs as the earnings foregone by students while in school are an important part of total social cost. However, they usually are neglected. By considering public education on the one hand, and on-the-job training on the other, it can be readily understood that the two should be treated in about the same manner. For instance, a shift of training from public schools to on-the-job reverses the emphasis on direct costs and makes all costs appear as foregone earnings.[3]

Four major cost categories emerge: direct operating cost, imputed operating cost, direct capital cost, and imputed capital cost. Each of these can be further subdivided, and a few comments are in order.

Spillover analysis of direct operating cost is best carried out in terms of major tax categories, i.e., property tax, sales tax, income tax, etc. This will be done in the next three chapters. Among the important direct operating costs are salaries for teaching staff, school administrators, and custodians, as well as the cost of supplies.

There are a number of significant imputed operating cost items in the provision of public education. These are earnings of students foregone by attending school, miscellaneous costs to students and parents in relation to school attendance, municipal services that are given to schools without charge, interest on direct operating cost, and interest on miscellaneous cost to students and parents relating to school and municipal service cost. The last interest item is most likely too insignificant to warrant analysis. But conceptually, it is important to realize that people who bear imputed operating costs to help finance education could use these funds in a variety of ways and obtain an income from them.

Direct capital costs can be subdivided into annual principal repayment and annual interest on outstanding bonds.

Finally, imputed capital costs can also be subdivided into two major categories. One is the annual capital consumption minus the principal repayment, and the other is the interest on equity.

The value of capital consumption during a given period is the change in capital value between the beginning and the end of the period. Concerning interest on equity, the following comments might be useful. When the capital facilities of a school district are financed by bonds, interest is a direct cost included in debt service payments on these bonds. If, however, the school district holds an equity in the capital facilities as a result of having retired bonds prior to actual capital consumption, it incurs the same interest cost on this capital, but the interest must be imputed since no actual money outlay is made. Therefore, interest must also be imputed on current resource costs. These cost concepts are summarized in Table 1.

Direct and imputed resource costs, in turn, may be further subdivided into internal and external costs. While internal costs are that portion of resource cost which is an ultimate burden upon residents of the community providing the particular service, external costs are an ultimate burden upon non-residents. The latter group is synonymous with intercommunity cost spillover.

Resource costs are chiefly spilled over upon residents of other communities through shifting tax burdens. Since most of the direct current and capital resource costs of public education are financed by the local general property tax, or state sales, excise, and income taxes, the incidence of these taxes upon non-residents determines the extent and magnitude of direct cost spillovers.

Imputed resource costs can also ultimately rest upon non-residents, i.e., they can spill over jurisdictional boundaries. The geographic burden of imputed costs can often be determined by abstracting from the institutional considerations which cause some costs to be classified as direct while others are designated imputed. Thus in some cases imputed costs are evaluated in the same manner as are direct costs, as if some change had been instituted which would convert imputed costs into direct costs. When so considered, the spatial spillover of imputed costs can be obtained through the structure of the spatial tax incidence models.

Table 1

Expenditure and Revenue Components of Annual Education Costs

Cost	Expenditure	Revenue
Direct Operating Costs	Operating of Plant Maintenance of Plant Fixed Charges Other School Services	Property Taxes Sales and Excise Taxes Income Taxes
Imputed Operating Costs	Foregone Earnings of Students Miscellaneous Costs to Students and Parents Municipal Services to Schools Interest on Direct Operating Costs	Earnings of Students and Parents Property Taxes Sales and Excise Taxes Income Taxes
Direct Capital Costs	Annual Principal Repayment Annual Interest on Outstanding Bonds	Property Taxes Sales and Excise Taxes Income Taxes
Imputed Capital Costs	Annual Capital Consumption Minus Principal Repayment Annual Interest on Equity Capital	Property Taxes Sales and Excise Taxes Income Taxes

The relation between all these cost concepts is summarized in Fig. 1. We have seen that the total opportunity cost of public education may be subdivided into three major cost classifications which identify (1) the nature of resources consumed — whether operating or capital, (2) the nature of the cost — whether direct or imputed, and (3) the geographic distribution of the cost burden — whether external or internal to residents of a community.

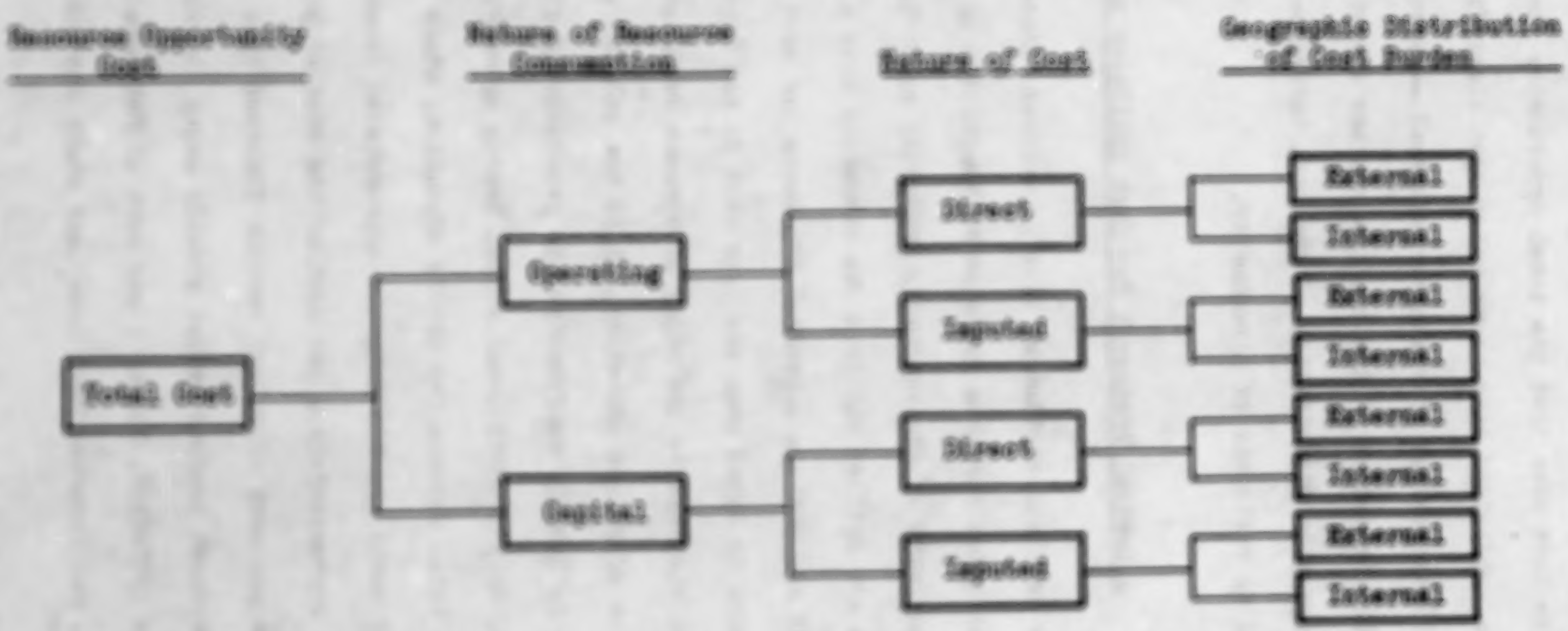
A General Framework for Cost Spillover Analysis

In the previous section we briefly defined intercommunity cost spillover as those resource costs which constitute an ultimate burden upon non-residents of the community employing specific resources. These costs are spilled out from one community into a second.

We will now outline a general framework for cost spillover analysis. This framework is based upon the fact that in the United States the local school district is the major government decision unit regarding the provision of public education, while the role of state and federal governments is largely confined to the provision of financial assistance. For example, in 1957-1958 local school boards appropriated about 55 per cent of the total revenue for public education; state legislatures, about 41 per cent; and the Congress appropriated federal funds which amounted to approximately 4 per cent of the cost of public education.[6] However, the per cent of school revenue financed from local, state, and federal government sources varied greatly among the states. For instance, in 1957-1958, 93 and 7 per cent of Nebraska school revenue, at one extreme, was financed from local and state revenue sources,

Fig. 1

Classifications of Social (Total) Cost of Public Education



respectively; on the other, 12 and 74 per cent of school revenue in New Mexico was financed from local and state revenue sources. While the final responsibility for public education resides in the state government, local school boards have been delegated taxation and other powers to operate local schools.

Most states have adopted foundation programs for support of public schools. These laws define certain basic educational services that should be available to all the children in the state and are financed through local tax revenues and funds granted from state revenues. The various methods and rules for allocating state revenue to local districts in support of these foundation programs is discussed later in this chapter under the heading of "Expenditure Analysis."

Local and state governments vary widely with regard to the type of taxes they employ and the social-economic-political structure of the communities they serve. Likewise, there is wide variation in the per cent of the taxes raised by different levels of government.

In 1957-1958 property taxes provided about 54 per cent of non-Federal school revenue in the nation. Local school districts are the primary users of this tax source — accounting for 98 per cent of school property tax revenue. There is, however, considerable variability between states in the importance of property taxes as a source of school revenue. In 1957-1958 Nebraska reported over 91 per cent of all school revenue from this source and Delaware, only 3.2 per cent.[3]

Non-property tax revenues for schools come chiefly from states, which accounted for 97.5 per cent of this tax source in 1957-1958. State non-property tax revenues are derived from a variety of sources including sales and income taxes; taxes on natural resources, amusements, and financial transactions; from fines, forfeitures and penalties; and in some instances, from charges for services such as tuition or transportation. For 1961, sales and gross receipts taxes accounted for 67.1 per cent of all state tax revenue, and general sales taxes alone for 23.7 per cent; state licenses accounted for 13.8 per cent, individual income for 12.4 per cent, and corporation income taxes for 6.7 per cent.[6]

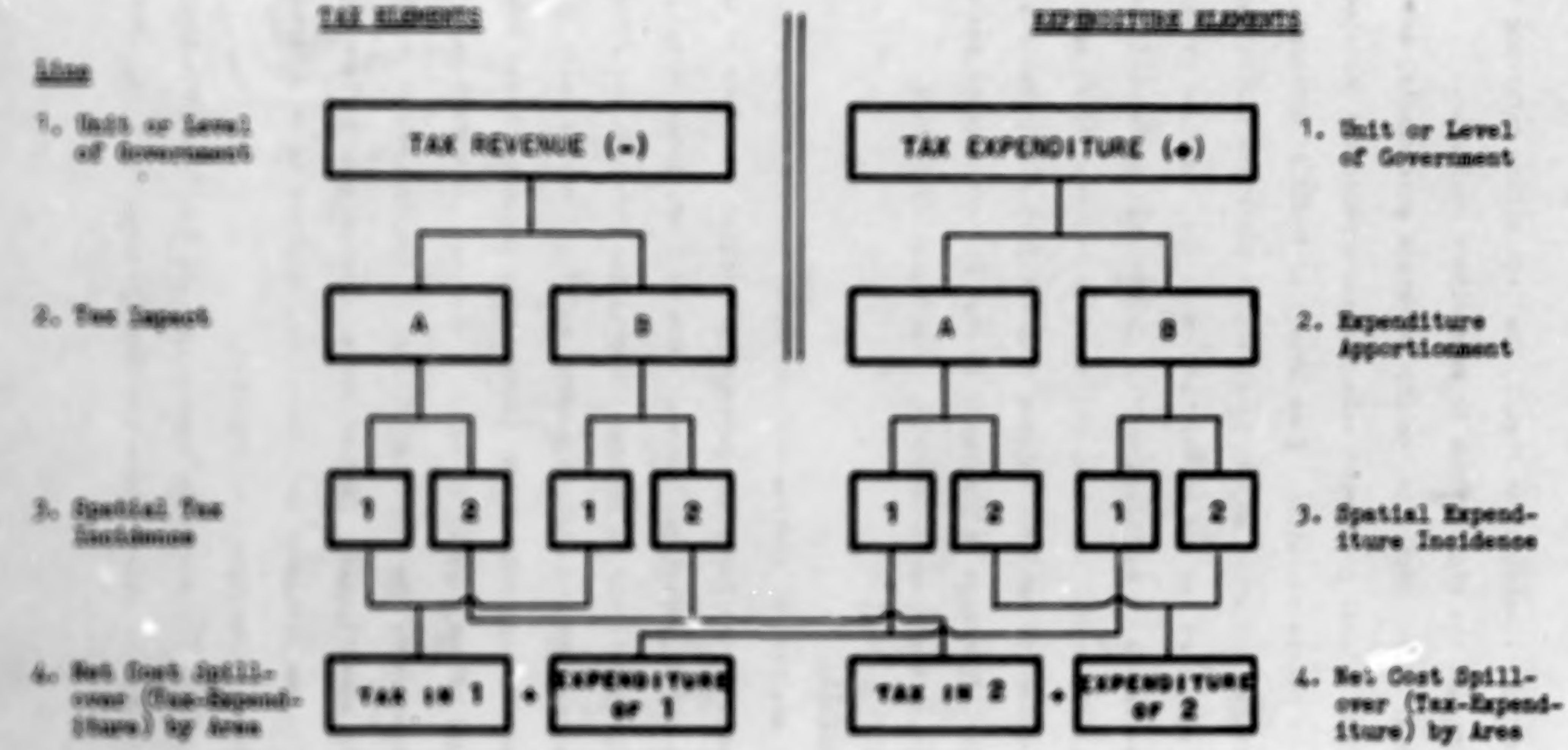
However, again there is great variation among the states in the importance of any single tax. General sales and gross receipts taxes in 1960 ranged from 21 to 86 per cent of total state tax revenues. Likewise, personal income taxes varied from a high of 42 per cent to a low of less than 4 per cent of total state tax collections. All these factors affect public education cost spillovers and they must be recognized individually in building a general framework for cost spillover analysis.

In the following pages this framework will be outlined with the aid of Fig. 2. A more detailed theoretical treatment will be developed and empirically implemented for a case study in subsequent chapters.

At the outset it is important to realize that public education cost spillovers can be influenced not only by tax, but also by expenditure, decisions. The net amount of resources a local community allocates for its public education is determined by its level of local taxes, their spatial burden pattern, and the proportion of local tax revenue spent on public education provided within the local community, as opposed to that spent outside it. Together, these factors determine the net balance between the ultimate resource cost or tax burden of a community and the amount of resources ultimately utilized for the provision of its public education. The latter is the expenditure incidence. This

Fig. 2

Major Elements of the Public Education Cost Spillover Framework


TAX ELEMENTS
EXPENDITURE ELEMENTS
Line
1. Unit or Level of Government
TAX REVENUE (-)
TAX EXPENDITURE (+)
1. Unit or Level of Government
2. Tax Impact
A
B
A
B
2. Expenditure Apportionment
3. Spatial Tax Incidence
1
2
1
2
1
2
1
2
3. Spatial Expenditure Incidence
4. Net Cost Spill-over (Tax-Expenditure) by Area
TAX IN 1
+
EXPENDITURE OF 1
TAX IN 2
+
EXPENDITURE OF 2
4. Net Cost Spill-over (Tax-Expenditure) by Area

dichotomy is illustrated in Fig. 2, the left column referring to tax decisions and the right column to expenditure decisions.

Local school districts, county and state governments, and to some extent the federal government make tax and expenditure decisions with regard to public education. (See Line 1 of Fig. 2.) Although, currently, fifty states and about 40,000 local school districts participate in public education tax and expenditure decisions, they can be aggregated into geographic or political units. In the most aggregated analysis, one specific school district, which may be referred to as area 1, wants to determine its net cost balance with the rest of the nation, area 2. This simplified case is portrayed in Fig. 2, which treats tax and expenditure decisions separately, to be taken up in turn.

Tax Analysis

An analysis of spatial tax incidence, i.e., spillover, must take cognizance of the fact that governments utilize a variety of taxes to finance public education. As was shown earlier, local school districts rely almost entirely on general property tax revenues and state governments mainly tend to utilize general sales and excise taxes and personal and corporate income taxes. When municipalities, which are identical or overlapping to school districts, use non-property tax revenue sources, the potential millage of the general property tax is freed by substitution. Each of these taxes behaves differently with regard to tax spillover and, therefore, deserves to be analyzed separately. (See Line 1 of Fig. 2.)

Total public education expenditure and tax revenue seldom are equal in any one year. There are three reasons for this. First, capital outlay, as opposed to current expenditures, is usually initially financed from bond issue revenue, and only in a later period are capital outlay costs borne by taxpayers when tax revenue is used to service and retire the bonded debt. The problem of differences between debt service, capital outlay, and capital consumption is discussed in detail in Chapter VII. Secondly, differences between total expenditure and tax revenue may result from changes in cash balances. For example, a school district may spend more on public education in a given year than it receives in tax revenue during this same period by drawing down school district cash balances accumulated during previous years. A third, and minor, reason for such differences is that a small portion of total public education revenue is derived from non-tax revenue sources. If we exclude public school revenue received under the federal lunch and milk program, federal assistance to impacted areas, student body activities, community services, summer schools, and adult education (since these activities are all excluded from public education expenditures), the federal government raises only a minor amount of education revenue from such non-tax sources as the sale of federal forest reserves, and from oil royalties, while state, county, and local non-tax revenues are derived from permanent funds and endowments and such miscellaneous sources as the sale of junk, fines, interest on bank deposits, and temporary rents.[7]

Since governments at all levels must rely almost exclusively upon tax revenues to finance their public education expenditure decisions, non-tax revenues are disregarded in calculating public education costs and their spillovers. We assume that direct current costs of education in a given year are equal to the amount of tax revenue levied to finance them.[8]

When a variety of miscellaneous tax revenue sources are utilized to finance public education, as at the state government level, only major tax sources are examined in order to facilitate the analysis. It is assumed that state subsidy payments are financed entirely from the major tax sources, ignoring existing earmarking of tax revenue and miscellaneous tax revenue sources. Changes in expenditure decisions are assumed to affect revenue requirements from existing major tax revenue sources. Tax revenues of local and intermediate governments come almost entirely from general property taxes. Excluding motor fuel and motor vehicle taxes, which may be assumed permanently earmarked for highway purposes, state governments in 1960 collected 61 per cent of total tax collections from sales and excise taxes, 25 per cent from personal and corporate income taxes, with the residual derived from property, death and gift, severance, and other miscellaneous tax revenue sources.[9]

Direct operating and capital expenditures of public education in the United States are overwhelmingly financed at either the local school district or state government level. In 1959-1960, 54.1 per cent of total public school revenue was derived from local government sources, 39.4 per cent from state, 4.4 from federal, and 2.1 per cent from intermediate government sources.[10] Excluding expenditures on special programs not included as part of the normal education program would further increase the proportion of expenditure financed from local and state revenue sources by approximately 2 and 1 per cent, respectively. Because of their relative insignificance, federal and intermediate government revenue sources are excluded in the empirical portion of the study.

Although 87 per cent of the total expenditure in the U.S. for capital outlay in 1956-1957 was financed from local school districts or school building authorities, and only 9 and 4 per cent from state and federal government revenue sources, respectively, we ignore earmarking of state funds for current expenditures.[11] Local school districts are often able to substitute state money earmarked for large current expenditure categories, for example, teachers' salaries, for local revenue used for this same purpose. As a result, although state apportionments are earmarked for current expenditure, in effect they finance capital expenditure by substituting for local revenue which then becomes available for this purpose.

The analysis of the final spatial tax incidence of a particular tax best proceeds from, first, an examination of the tax impact (Line 2 of Fig. 2), and, second, an examination of the final spatial tax incidence (Line 3 of Fig. 2). There are a number of tax impact categories, and varying characteristics within a category. For example, in the case of the general property tax, useful tax impact categories are the following: (1) physical category of tax base, (2) property use, (3) ownership, (4) spatial distribution of establishment, and (5) legal characteristics. Thus, the tax impact of the general property tax will tend to vary depending on the nature of the physical tax base on which it is levied: (A) real property, (B) personal property, (C) intangible property, etc. Another category relates to the uses to which property is put. For example, real property can be used for (A) commercial, (B) residential, (C) industrial, and other purposes. These uses affect the tax impact no less than ownership characteristics of the tax base: whether the property is (A) owned or (B) leased; or the spatial distribution of outlets: whether there are establishments (A) only within the district or (B) beyond the district; or legal characteristics of the tax base: whether (A) it is owned by a corporation or (B) it is a partnership.

The tax impact categories of a general retail sales tax differ, on the other hand, according to the type of establishment: (A) sales of retail food and service establishments are often exempt from sales taxation, while (B) most others are not. Although a state sales tax may not be levied against interstate trade, it is useful to distinguish between taxes paid by business (A) on their sales, as opposed to those paid (B) on their purchases, in order to determine what portion of the tax is paid by people outside the state through inclusion of the tax in the price of products. Income taxes vary not only because their initial impact is upon (A) personal as opposed to (B) corporate income, but also because of the size of the impact unit, for example, the number of exemptions resulting from family status of the individual, i.e., whether the individual is (A) related or (B) unrelated; also his gross and net taxable income class plays a role.

Having identified the impact of a given tax revenue according to various impact categories, and analyzed their characteristics, the second step can be taken, which is determination of the final spatial tax incidence (Line 3 of Fig. 2). The general spatial tax incidence model must permit the determination of the geographic incidence of taxes in terms of specified jurisdictions. As with tax impact, there are a number of spatial tax incidence categories and varying characteristics within each. For the example of the general property tax, the following spatial tax incidence categories are useful: (1) economic interest,

(2) functional and (3) final spatial incidence. Individuals pay taxes in their capacities as (1) property owners, (2) consumers and (3) profit recipients. Depending upon the economic interest grouping into which the individual falls, the tax burden will differ. Attention must also be given to possible functional characteristics of economic interest categories, for example, whether the profits individuals receive are in the form of corporate dividends or proprietorship earnings, or whether state and local taxes can be offset against the Federal income tax liability. The burden of a state's or district's taxes upon its residents is offset when payment of such taxes leads to a reduction of residents' Federal tax liability. Federal tax liability is lower either because state and local taxes can be deducted from income otherwise subject to Federal income taxes, or because state taxes reduce gross income and thus lower Federal tax liability.

The geographic aspects of the final spatial tax incidence are determined by the geographic location of the firm or individual on whom the ultimate tax burden rests. A corporation that manufactures goods for a national market has a different spatial dispersion of customers than has the small specialty shop. Likewise, stockholders of a national corporation are probably more dispersed spatially than owners of a small retail store. The individuals who incur the ultimate tax burden in their roles as (1) property owners, (2) income recipients, (3) consumers, (4) dividend and earnings recipients, etc., are identified according to their legal residence in terms of specific geographic-political areas. Although an individual may incur the ultimate incidence of a tax in the course of working, shopping, or passing through a jurisdiction, the ultimate spatial burden is assigned to his legal place of residence, the point where he, individually, is given weight in the decision process of providing public education.

The sum of all individual public education tax burdens that fall on the legal residents of a jurisdiction can be aggregated to represent the total burden placed upon community resources (Line 4 of Fig. 2). The aggregate burden upon community resources is the summation of burden resulting from local education, plus burden resulting from education provided by all other communities (cost spillin). This aggregate tax burden constitutes one side of the cost balance sheet. Total resources made available by all governments for the provision of public education are on the other side. They will be examined next.

Expenditure Analysis

Each of the units or levels of government that levy taxes for support of public education also makes explicit decisions about the geographic area in which the tax revenue it collects is spent (Line 1, Fig. 2). A major concern of this study is the identification of the area in which tax revenues are used to purchase resources for the provision of public education, rather than how efficiently these resources are utilized to attain educational objectives.

Local school districts typically spend almost all locally raised school revenue on education provided in their own districts. Since an expenditure analysis is only required when a portion of school revenue is spent for education in geographic areas other than the one in which it was collected, as are the expenditures of state governments,[12] expenditure categories and elements of Fig. 2 may be collapsed into a single element for the examination of local school district expenditure.

State governments, and also the federal government, have varying purposes for spending or distributing funds to local school districts in support of public education. These may be identified according to (A) general-purpose and (B) special-purpose distributions or expenditures (Line 6, Fig. 2). General-purpose distributions are allotted to local school units with the single stipulation that they be used for educational purposes. Others, which identify and support a specific portion or feature of the school program, are regarded as special-purpose distributions.

General-purpose distributions are provided for all school systems that meet the qualifying conditions and choose to participate. Local school boards are at liberty, with few reservations, to use the funds for general current expenditures at various levels of the school program.

Special-purpose distributions, however, are specifically limited. Conditions are stated which restrict the use of funds, place strong limitations on district participation, determine certain items of the budget, or specify limited use for given areas of the school program. These distributions may be directed toward such purposes as transportation, education of physically handicapped children, rehabilitation of school buildings, adult education, textbooks, health services, and school lunches.

A third type of grant, the incentive grant, is in existence in some states.[13] The idea that lies behind this grant is that local school districts should not only be encouraged to undertake new projects but that they should also be encouraged to carry them out as economically as is justifiably possible. If the state pays a flat percentage of a local district's expenditure on a certain purpose, all of the marginal costs of the purpose in question are reduced. Consequently, there is a reduction in the incentive to do things as cheaply as possible. However, where the state makes a certain grant per further measure of a particular kind, only the marginal costs that are necessarily added by the additional unit of the kind in question are reduced. In this case, the local district enjoys 100 per cent of the benefit from economizing on the expense of carrying out the added activity.

In practice the line of demarcation between general- and special-purpose distributions is not always readily distinguishable. Special distributions restricted to teachers' salaries, for example, would probably not hamper school boards in making expenditures, since this item accounts for such a large proportion of the school budget. When local as well as state monies are expended for a given purpose, special-purpose funds may not appear restrictive to local boards of education if audits of state apportionments only determine that as much as was allotted by the state was expended for the purpose.

The 48 states distributed a total of $4.3 billion to local units for public education in 1957-1958, of which 82.3 per cent was classified as general-purpose, and 17.7 per cent as special-purpose, distributions.[14]

General- and special-purpose funds may be further sub-categorized according to the methods of revenue distribution. They may be divided into two main classes — (A) flat grants and (B) equalizing grants. Flat grants are allotted to school districts in proportion to such measures as number of children, pupils, teachers, classrooms, schools, and percentage of cost. No estimates of financial ability are used in calculating flat grants to school districts.

The objective of a flat grant is to help create local district tax leeway, so that local initiative can provide additional, locally desired, education services. Equalizing distributions are also allotted in recognition of program factors but adjustments are made on the basis of the financial ability of school districts. Under these equalizing programs, communities able to levy sufficient taxes to support an excellent local school program receive smaller proportions of state money than those less able to pay. The objective of equalizing funds is to raise the level of support for the financially weaker school districts of the state.

Equalizing distributions may assume a variety of forms. They may support foundation programs which (1) use measures of local financial ability, (2) require minimum local tax contribution, or (3) supplement local funds to attain a minimum program level. Equalizing aid may also be given to school districts under emergency conditions arising from problems brought about by storms, fires, or budget deficits.

While flat grants do not include estimates of financial ability in calculating distributions, they have some equalizing effects. States that derive most of their revenues from the more prosperous high income areas, and which apportion funds to school districts on a flat grant basis, in effect share these concentrations of wealth with all districts of the state.

Of total state fund distributions in 1957-1958, 51.9 per cent were general-purpose equalizing grants, 30.4 per cent general-purpose flat grants, while 6.7 per cent were special-purpose equalizing, and 11.0

per cent were special-purpose flat grants. Equalizing grants thus accounted for 30.6 per cent and flat grants for 69.4 per cent, respectively, of total state fund distributions in 1957-1958. Within these figures, however, there was great variation. At one extreme, Ohio apportioned 99.3 per cent of its state fund distributions through equalizing grants, and at the other, Arizona, Delaware, Nebraska, South Carolina, and South Dakota apportioned 100 per cent of their state fund distributions through flat grants.[12]

In order to determine the dollar amount for which each district qualifies under a state support program, a basis must be established for translating state fund distribution programs into amount of aid for a school district budget. The established bases which states usually utilize for both flat and equalizing grants are either (A) children or pupils, or (B) classroom units. General-purpose flat and equalizing grants, utilizing children or pupils bases, often include such factors as school census, enrollment, average daily attendance, days of attendance, average daily membership, and number of teachers. Grants which utilize classroom units bases include other factors such as salary schedule (cost or per cent thereof), and population density. Using salaries based on an approved state salary schedule to determine equalizing grants, however, tends to cancel much of their originally intended equalizing effect by supporting higher expenditure levels in districts whose teachers are at the upper, rather than lower, ranges of the schedule.

The bases for distributing different types of special-purpose funds are varied, those for vocational and special education often distributed on the basis of "approved program" and "excess cost." While measures of pupils or teachers, and the training of teachers, do not appear as bases for distribution, they enter into the determination of the "approved program" or the "excess cost" amounts. Similarly, some measure of cost is used for school buildings.

Under all apportionment programs the total revenue allotted by the state or other governmental decision units to the areas of analysis determines the final spatial expenditure incidence (line 3, Fig. 2). Since the exact revenue source of this allocation is rarely known, specific assumptions must be made for the sake of such an identification. For example, it may be assumed that any single tax source is represented in an apportionment to the extent that it contributes to total education revenue. The sum of all revenues apportioned to an area, under all apportionment programs of all governments, determines total expenditure of resources available to a specific area for public education.

Net Cost Spillover Balance

The difference between total public education tax burden and total education resource expenditure of an area determines its net cost spillover balance (line 4, Fig. 2). It is the sum of all cost spillins and spillouts. An area which experiences a net cost spillin is incurring a greater total public education tax burden than the amount it is expending on education. This is made possible by other areas experiencing a net cost spillout; resources devoted to public education within these areas exceed total education tax burden.

The general application of the cost spillover framework may be illustrated by the following example. The cost figures of the example are hypothetical; actual empirical estimates would require detailed analysis of the major tax and expenditure categories of Fig. 2.

Let us consider cost spillovers of public education provided in school year 1959-1960 in the city of St. Louis (Line 4, Fig. 2, area 1) in relation to the rest of the United States (Line 4, Fig. 2, area 2). In that year, St. Louis City levied $40 million in local taxes for its local public schools and was able to shift 50 per cent or $20 million of the cost burden to residents of the rest of the United States by including these costs in the price of goods and services sold. In the same year, local school districts in the rest of the United States levied an aggregate of $10 billion in taxes for public education, of which only $10 million was shifted to St. Louisans as an ultimate burden. Thus, St. Louis had a net cost spillout of locally financed public education costs of $10 million.

In the same year, the state of Missouri levied $100 million in public education taxes, of which St. Louisans bore 30 per cent or $30 million in ultimate burden, and received back $20 million in state apportionments (Line 1, Fig. 2). Since St. Louisans bore 30 per cent of the state tax burden, 30 per cent of the state apportionment to St. Louis or $6 million may be assumed to be St. Louisans' own money and a cost of their education, and the balance of $14 million a spillout of St. Louis education cost to the rest of Missouri. However, the rest of Missouri received $80 million in state apportionments of which 30 per cent of $24 million was spilled into St. Louis. As a result of Missouri state financed education cost, St. Louis had a net cost spillin of $10 million.[16] St. Louis is, therefore, in net balance with respect to the sum of locally financed, and Missouri state financed, public education costs.

In the same year, the other states of the United States levied a total of $5 billion in state public education taxes, of which .3 per cent of the burden, or $15 million, ultimately rested on St. Louis residents. None of this revenue was returned by the states as an apportionment in support of St. Louis public education.

Thus, when all three unit levels of government are included, St. Louis residents incur a net resource cost burden of $15 million, which is the difference between the $75 million total public education tax burden of all levels of government resting on St. Louisans, and the $60 million actually apportioned to provision of public education in the city of St. Louis.

The direct costs of the resources utilized by a school district, city, state, or the nation in the provision of public education are usually registered by these units of government on their accounting statements of public education expenditure. They are summarized in Table 2 for the United States in school year 1959-1960 with relation to six geographic areas, and are utilized in subsequent chapters to demonstrate and implement the general cost and benefit spillover model. Direct costs are further identified according to the relative revenue contribution by local and state governments for their financing. Since the federal and intermediate level governments contribute a minor portion of total public education revenue, all revenue was assumed derived from local and state government revenue sources.

Table 2

Direct Cost of Public Elementary and Secondary Education in the United States, 1959-1960, by Select Geographic Areas (in $000)

Area* (1)	Level of Government Financing (2)	Per cent of Total (3)	Direct Operating Cost (4)	Direct Capital Cost (Principal Repayment plus Interest on Bonds) (5)	Total Direct Cost (6)
1	Local	90.0	$ 1,578.3	$ 200.6	$ 1,778.9
	State	10.0	174.8	22.2	197.0
	Total	100.0	1,753.1	222.8	1,975.9
2	Local	79.6	33,130.7	4,650.0	37,780.7
	State	20.4	8,480.3	1,190.2	9,670.5
	Total	100.0	41,611.0	5,840.2	47,451.2
3	Local	76.6	24,904.6	1,452.4	26,357.0
	State	23.4	7,625.0	444.6	8,069.6
	Total	100.0	32,529.6	1,897.0	34,426.6
4	Local	70.5	25,366.8	3,739.5	29,106.3
	State	29.5	10,599.2	1,562.5	12,161.7
	Total	100.0	35,966.0	5,302.0	41,268.0
5	Local	56.8	90,950.0	7,945.9	98,895.9
	State	43.2	69,201.4	6,045.8	75,247.2
	Total	100.0	160,151.4	13,991.7	174,143.1

Table 2, Part ii

(1)	(2)	(3)	(4)	(5)	(6)
6	Local	56.2	$ 6,773,299.3	$ 704,999.1	$ 7,478,298.4
	State	43.8	5,278,834.6	549,447.7	5,828,282.3
	Total	100.0	12,052,133.9	1,254,446.8	13,306,580.7
Total All Areas	Local	56.4	6,949,229.7	722,987.5	7,672,217.2
	State	43.6	5,374,915.3	558,713.0	5,933,628.3
	Total	100.0	12,324,145.0	1,281,700.5	13,605,845.5

* Area 1 = Clayton, Missouri School District
Area 2 = Rest of St. Louis County, Missouri
Area 3 = City of St. Louis
Area 4 = Rest of St. Louis SMSA
Area 5 = Rest of State of Missouri
Area 6 = Rest of Contiguous U.S.

Sources: St. Louis County Superintendent of Schools, Annual Report 1959-1960; U.S. Department of Health, Education, and Welfare, Preliminary Statistics of State School Systems 1959-1960, Circular No. 663, July 1961, Tables 5 & 6; One Hundred Sixth Annual Report, Board of Education of the City of St. Louis for the Year Ending June 30, 1960; U.S. Department of Commerce, 1957 Census of Governments, Finances of School Districts, Vol. III, No. 1, Table 4, and Summary of State Government Finances in 1957, 1960 and Governmental Finances in 1957, 1960.

Chapter III

LOCALLY FINANCED OPERATING COSTS OF PUBLIC EDUCATION

Introduction

A major proportion of the direct operating cost of public education is financed by local property taxes. Economic circumstances permit taxpayers to shift the ultimate burden of these taxes to other individuals in various proportions and under different conditions. Hence shifting and incidence analysis of property taxes is a key issue in a study of intercommunity cost spillover of public education.

This chapter will outline a model of spatial tax incidence related to property taxes. It will present a technique of implementing the model, report on the empirical findings of this methodology when applied to a particular case study, and attempt some generalizations.

General and Theoretical Considerations

The Spatial Property Tax Incidence Model

The spatial property tax incidence model was formulated with the objective of determining the geographic incidence of tax revenue raised by designated political units in various divisions and levels of government for financing public education during a specific time period, i.e., an academic year. A static time period analysis of cost spillover is therefore visualized. It indicates, in the terminology of the economist, a short-run, partial equilibrium approach to the analysis of tax incidence.

Before beginning, however, it is important to realize the limitations of such an analysis. In an advanced industrial society, the incidence of a tax in the most complete sense would include redistributional effects of the tax levy itself and of the expenditure of the tax revenue, after all repercussions had worked themselves out. A complete analysis of incidence would thus compare an economic system in equilibrium before the tax with the system after the tax and tax revenue expenditure had been imposed and a new equilibrium established. Not enough is known about the speed and extent of reactions of people and markets to permit the solution of such an ambitious general equilibrium system, and, therefore, the rough shifting assumptions of our partial equilibrium analysis cannot pretend to assess the ultimate incidence of taxes in a general equilibrium system. We only deal with money burdens, not complete incidence.

The specific question of tax incidence may be stated in two different ways: (1) What is the incidence of a given political jurisdiction's incremental levy of one of the taxes of concern, i.e., incidence of a marginal tax? (2) What is the incidence of a given political jurisdiction's present levy of a specified tax, i.e., incidence of an average tax?

Both of these questions may be introduced and analyzed in a shortrun tax incidence model. This methodology is most appropriate but depends upon the unit or level of government studied and on whether the overall direct cost of public education is contracting, constant, or expanding during the period of analysis. A local school district, for example, would most likely be forced to raise general property taxes if faced with the necessity of expanding it education program. On the other hand, the state or federal government might be in a position where constant tax rates are increasing its total tax revenue, from which it can therefore readily appropriate additional money for education. Either formulation will produce identical incidence results in situations where the economic structure is in equilibrium, i.e., when all past tax changes have worked themselves out and a marginal tax increase is negligible in terms of the current tax structure. Where these conditions do not apply, the question of tax incidence must be posed according to the relevant economic and political conditions of the jurisdiction that is financing public education. While a short-run tax incidence analysis may be utilized for either form of the question of tax incidence, once the selection between a marginal or an average tax has been made, the same form must be used consistently throughout the tax incidence model.

In this short-run, partial equilibrium approach it is assumed that no part of the property tax is shifted backward to wage earners. Backward shifting appears to be negligible for the following reasons: (1) The supply of taxable property is relatively fixed in the short-run. Thus, irrespective of the fact that in the long-run, the supply of property is a function of the price of construction workers employed in the production of property, the tax would not be shifted to these workers in the short-run. (2) The wage rate of labor employed in the taxing jurisdiction is determined through competition in a larger labor market. Labor could easily migrate in the short-run to an untaxed area. Furthermore since much of labor is unionized, it would attempt to withhold its supply if an attempt were made to shift the tax in its direction in the form of reduced wages. (3) Since property taxes are levied on a single factor of production (capital), the ultimate substitution of labor for capital in the long-run would in general tend to raise rather than reduce wages.

The analysis of tax shifting in this model is concerned both with the incidence of a given jurisdiction's tax levy, and with the amount of taxes shifted into the tax jurisdiction from all outside taxing jurisdictions. If all districts simultaneously raise their taxes, the problem of incidence for regional taxes does not significantly differ from that for national taxes.[1] Incremental taxes that are special in the first instance become common when other districts also raise their taxes. All units are assumed to be in a position of equilibrium initially due to past tax levies. General incremental tax changes are assumed not to be radical in nature, and not to disturb the existing average spatial tax incidence pattern. We therefore do not analyze the problem of differential burden among competitors in a common market, and ignore the complication in aggregative economies of spatial migration of firms. There is no analysis of the degree of change in taxes that might induce business firms to move into or out of the taxing jurisdiction. Workers and consumers are assumed to be mobile and able to make adjustments when threatened by adverse changes in the tax structure.

The final assumption pertains to the position occupied by intermediaries. The number of times goods are handled by wholesalers and middlemen, or as ingredients for the products of other firms prior to reaching the final consumer, is not considered to affect the shifting and incidence of general property taxes. The tenant of residential property is not considered a member of a separate economic interest group, but rather as the consumer of this property.

Major Elements of the Spatial Property Tax Incidence Model

The general property tax incidence model and its major components are presented in Fig. 3, which also serves as a guide to Figs. 4 and 5 that follow.

The tax incidence model can be discussed in terms of two major groupings—(A) tax impact, and (B) spatial tax incidence—both of which are common to all taxes. However, there is some variation within the impact and incidence groups because of differences between political units in specifying the legal tax base, as well as in the nature of the tax shifted. The general procedure of analyzing geographical tax incidence begins with determining the amount of revenue collected through a designated tax by a given political unit or aggregation of units for the purpose of public education. Then the geographic burden of this tax is ascertained by tracing the shifting process from point of impact, i.e., the person or corporate body legally liable to pay the tax, through intermediaries, to the point of final spatial incidence. It is necessary to subclassify each of the successive major groupings and their elements whenever a reason exists for the tax to be shifted beyond the boundaries of the levying jurisdiction. The elements of each of the major groupings will now be discussed in the same sequence as in the tax shifting process. Reference will be made to Fig. 3 and Fig. 4, in which each element constitutes a separate line.

A. Tax impact. The local school district annually levies and collects general property taxes to finance public education provided within its jurisdiction. A portion of this tax revenue ultimately becomes a burden to residents of other areas, i.e., is spilled out. Other local school districts throughout the country also collect general property tax revenue, a portion of which ultimately becomes a burden to residents of the initially designated area, i.e., is spilled in. In order to determine the net cost spillover position of a school district (or any other political unit) vis à vis another designated unit or aggregation of units, the revenue collected for public education from a given tax must be separately analyzed for each unit to determine the amount of the tax collected in each unit that was ultimately borne in the other jurisdiction.

The purpose of the tax impact categories is to trace the legal impact of a tax, both with respect to the economic definition of the tax base and the functional categories of property or business, in order to identify differing spatial tax shifting among the various impact categories. When the impact and final incidence unit are one and the same, no differential shifting exists between the impact units—the tax impact and incidence is either within or outside the political taxing jurisdiction.

Tax impact divides into six main categories: (1) revenue category, (2) tax category, (3) property use category, (4) ownership category, (5) spatial distribution of establishment category, and (6) legal category. Tax laws often specify which general form or portion of a tax base is taxable (element 2). For example, property tax laws usually specify five tax base types: land, improvements, personal

Fig. 3

Major Elements of the Property Tax Spatial Incidence Model

Line

A. 1-6 Tax Impact

1. Revenue category
2. Tax category
3. Property use category

	The following symbols appear in Figs. 4 and 5.
4. Ownership category	O : Owned R : Rental
5. Spatial distribution of establishment category	L : Local (establishments only within the district) D : Dispersed (establishments within and outside of the district)
6. Legal category	C : Corporate NC : Non-corporate

Fig. 3

Part ii

B. 7-9 Spatial Tax Incidence

7. Economic interest category

W : Property owner
C : Consumer
P : Profit recipient

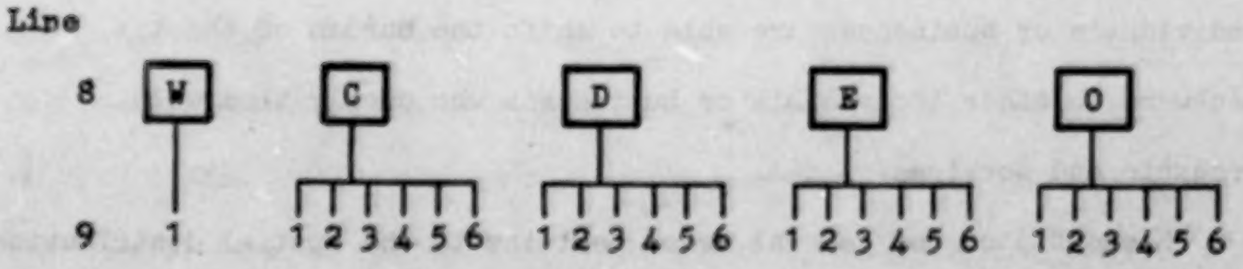
8. Functional category

W : Property owner
C : Consumer
D : Dividends recipient
E : Earnings recipient
O : Federal and State Tax Offset—indirect contributor

9. Final spatial incidence

1 : School District
2 : Rest of County
3 : Adjacent Core City (County)
4 : Rest of SMSA
5 : Rest of State
6 : Rest of U.S.

The following relationships hold for Figs. 4 and 5



household property, intangible property, and merchants' and manufacturers' inventories. Different tax or assessment rates may be applied to each of these types of property and each may have a different ultimate spatial incidence.

Use of the taxed property is designated as element 3. While tax laws may not specifically designate differential treatment, the assessment ratio, delinquency rate, or the ultimate spatial burden may differ for various classifications of property. For example, real property taxes levied on improvements fall on six types of property uses: residential, retail, office, industrial, utility, and agricultural and mineral.

Element 4 of the model is the ownership category. Individuals may either own or rent the property where they reside and, likewise, they or their employers may own or rent the retail, office, industrial, or farm property where they work. The financial transaction between property owner and property renter presents an opportunity for short-run shifting of tax burden. In the case of a tax on residential property, the owner of rental residential property may shift all or a portion of the burden of property taxes to his tenants, whereas the owner who lives on the property does not have this same opportunity. Although the ownership category of the model is probably less important for other types of taxes, it may be significant when individuals or businesses are able to shift the burden of the tax backward to other individuals or businesses who supply them with products and services.

Element 5 of the general model pertains to the spatial distribution of establishment category. Firms that have business establishments both inside and outside the taxing jurisdiction may be in a better position to shift the burden of the tax. The ultimate spatial tax incidence that falls on a business firm with widely dispersed outlets is likely to differ from a business that has only a single outlet within the taxing jurisdiction. For example, the relatively greater inaccessibility of property tax information, higher turnover with smaller inventory, stock manipulation, etc., may permit chain stores to shift a larger amount of a property tax than a single-unit store. If chain store customers are also more dispersed, the ultimate spatial incidence of a property tax would differ greatly between these two firms. The services of chain stores and independents are each partly unique so that they do not fully compete against each other, but only against stores of like kind. However, chain stores are probably able to absorb more tax burden if they wish to attract business from independents or perhaps crowd them out of competition. Even though owners absorb the tax burden, the spatial distribution of establishments may still be significant if their owners are more dispersed than those of the single outlet store.

A further important distinction for tax shifting lies in the legal structure of the firm, whether its organization is corporate or non-corporate (element 6 of the general model). Corporations with outstanding issues of corporate stock probably have a wide spatial distribution of ownership. They may also, on the average, serve a more widely dispersed consumer market than unincorporated firms. The ultimate incidence of taxes levied on firms with different legal structures therefore also probably differs. The legal form of organization, moreover, has a differential effect upon a firm's total tax liability, since under federal and state income tax laws different tax schedules are applied to incorporated and unincorporated firms. Not only does total tax liability, based on comparable average tax rate, differ for similar firms with different legal structures, but also the marginal tax rates differ. Since taxes paid one government unit may be deducted from income in determining net taxable income liable to another government unit, an incremental tax increase by one government may be partly exported by reducing the tax liability to another. Therefore, when different marginal tax rates apply, the amount of the tax so exported will also vary between types of firms.

B. Spatial tax incidence. The first element of this group (element 7 of the general model) for the first time relates tax incidence to individuals, with special emphasis on their economic interests or functions. Assumptions are made explicit at this stage of the general model regarding the percentage of the tax that is shifted to other persons by individuals or corporations on whom the legal impact rests. The main economic interests of individuals in this context relate to their roles as property owners, consumers, or recipients of income, i.e., wages, interest, and profits. Depending on legal structure, profit is distributed in the form of either dividends or earnings. Whenever an individual bearing the initial impact is unable to shift the tax, the impact and intermediate incidence are similar to those of the general property tax on the homeowner.

The market structure of a product is an important factor in the shifting of taxes. Firms that sell in a competitive market must accept the price set by the market and cannot readily shift the tax to consumers. For example, a firm engaged in agriculture or mining usually sells its products in competitive markets and therefore seldom can shift an increment in its taxes to consumers. On the other hand, as a result of spatial location, lack of competitors, or technical know-how, firms that sell products in a protected market can partly determine their price and are also probably in a better position to shift the tax. The market structure may be the result of various factors. The small specialty shop may be able to pass on a tax because of a location advantage; the public utility firm, because regulating agencies include taxes as costs in setting utility rates; there may be collusion between firms of an entire industry which would facilitate price fixing and shifting of tax burdens; the stage of the business cycle is also a factor that determines the competitiveness of a market and, therefore, the relative ability of firms with different markets to shift tax burdens.

The next element of tax incidence, following the economic interest category, is the functional category (element 8 of the general model). A property tax increase by a local government jurisdiction will decrease the net taxable income of firms and individuals for state and federal government income tax purposes. For example, if a homeowner pays $100 to the school district in real property taxes, he can itemize this payment on his federal income tax statement and reduce his taxable income. The amount by which his federal taxes are reduced depends upon the marginal tax bracket into which his income places him. If he is in the 30 per cent marginal bracket and his taxable income is reduced by $100, the decrease in his payments to the federal government is $30. If it is assumed that federal revenues are held constant and tax rate adjustments are made for the amounts offset by residents of all school districts, the burden of the offset ($30, in the above example) will fall upon residents of all jurisdictions according to their tax liabilities and tax brackets.

Final spatial incidence is the last element of tax incidence (number 9 of the general model). It attempts to attach an address to the tax burden. The final spatial incidence of a tax is determined by the area of geographic residence of the individuals comprising the different economic interest groups and functional share categories. There were over 40,000[2] local school districts in the U.S. in 1960. The final spatial incidence of taxes levied for public education could theoretically be determined by as many geographic areas. However, only a few units are of significance to any one school district. A school district (1) located in a suburban area of a Standard Metropolitan Statistical Area (SMSA) for example, would mainly be concerned with the status of its public education cost and benefit spillover with the following units: (2) rest of county in which it is located, (3) adjacent core city (county), (4) rest of SMSA, (5) rest of state, and (6) rest of U.S. (and possibly the world).

Six geographic areas may thus be designated, although areas (2) and (3) might not be relevant in all conditions. Each must also be mutually exclusive of all other areas designated in the study. The analysis will show all spillovers of public education cost — both spillins and spillouts — between each of the designated geographic areas and the school district under study. Any one of the designated areas may thus directly compare its net spillover position with any of the other five.

Tax Categories and Their Relation to the Model

As can be seen in Fig. 4, there are five main tax categories: land, improvements, personal household property, intangible property, and merchants' and manufacturers' inventories. They will now be examined in relation to the spatial property tax incidence model.

Real property: land and improvements. Property taxes, whether levied on land or improvements, are considered to have an identical incidence system. However, the coefficients are likely to differ. Property taxes on land, especially rural land, fall partly upon economic rent and partly upon land improvements. The portion ascribed to economic rent is assumed borne by the owner while the portion to improvements may be shifted in part to others. Real property taxes are usually levied on the bundle of land and improvements, and therefore it is difficult to determine what portion of the levy is a tax on site value which would exist in the absence of any improvements. An added tax solely on land or site value, however, tends to add to the supply of available land through more intensive utilization, and therefore decreases land rents. New owners of land, moreover, tend to be relieved from the burden of future land taxes through tax capitalization. The stream of future taxes to be paid represents a reduction in the net benefit, and hence in the present capital value.[3] An incremental change in the mix of land and improvement taxes can change land use and therefore the pattern of spatial burden because: (1) The supply of land used for a given function, even in urban areas, may not be perfectly inelastic as a result of possible changes in land use. (2) Tax rates on land used for different purposes vary because of assessment practices. As a

Fig. 4: Part i

Incidence of the General Property Tax

Theoretical Model

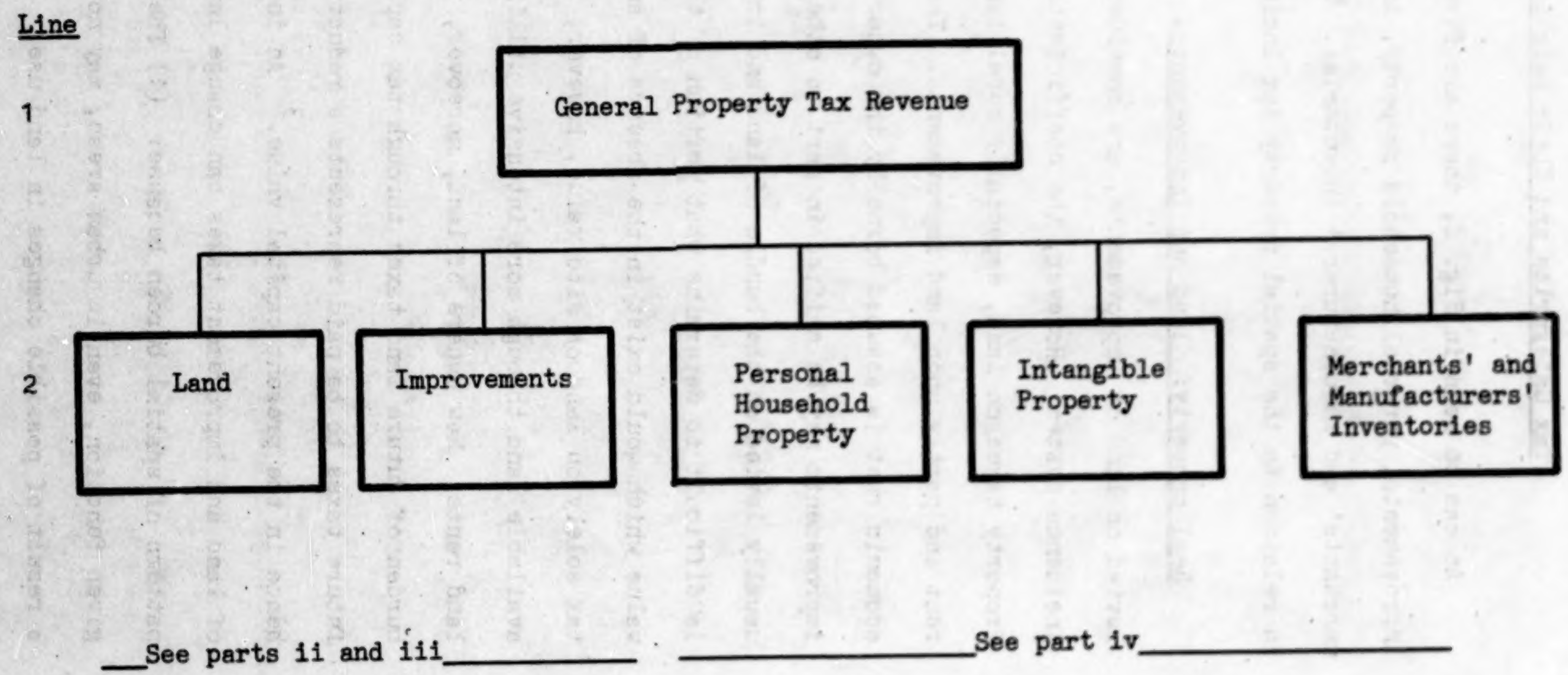

Line
1
2
General Property Tax Revenue
Land
Improvements
Personal Household Property
Intangible Property
Merchants' and Manufacturers' Inventories
See parts ii and iii
See part iv

Fig. 4: Part ii

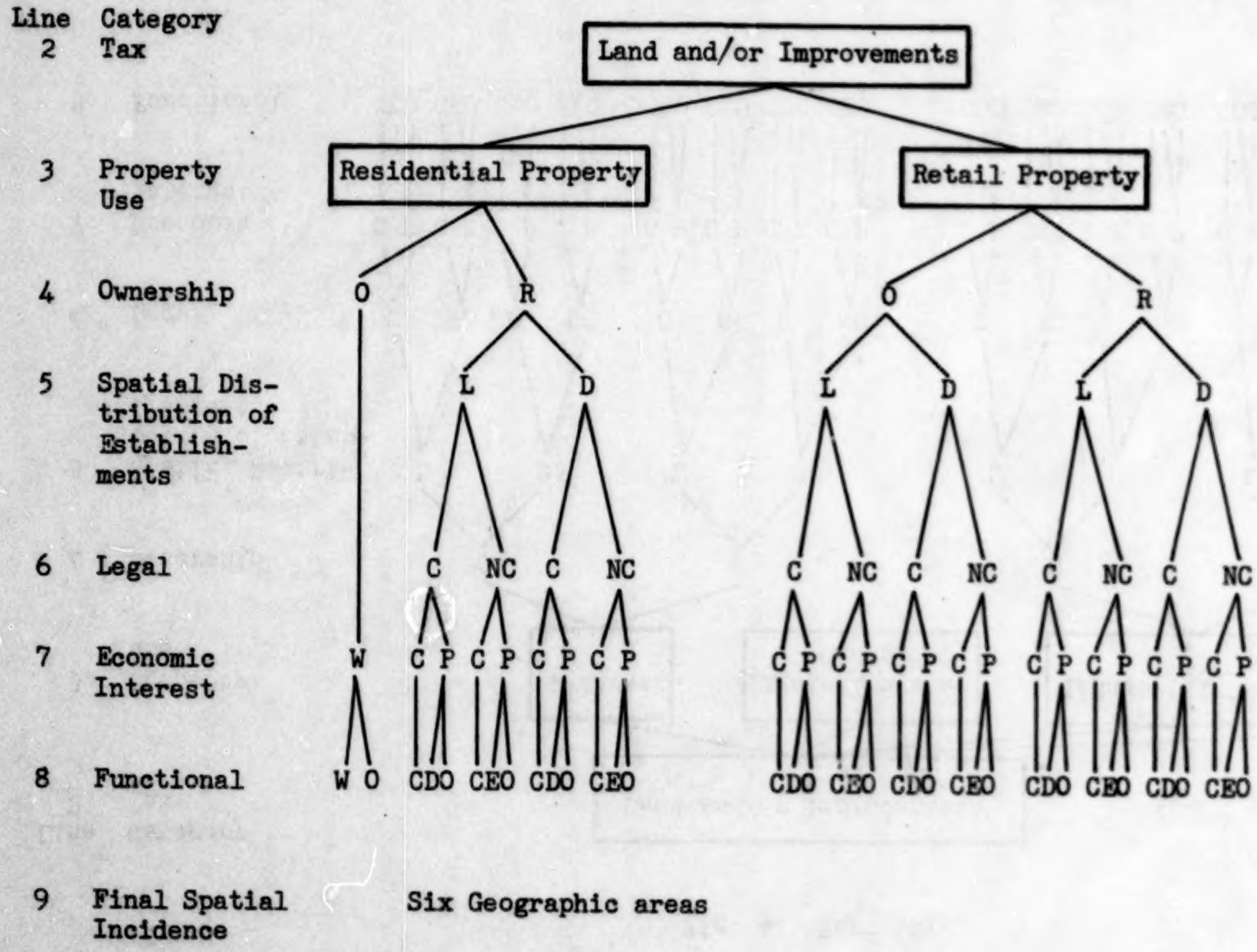
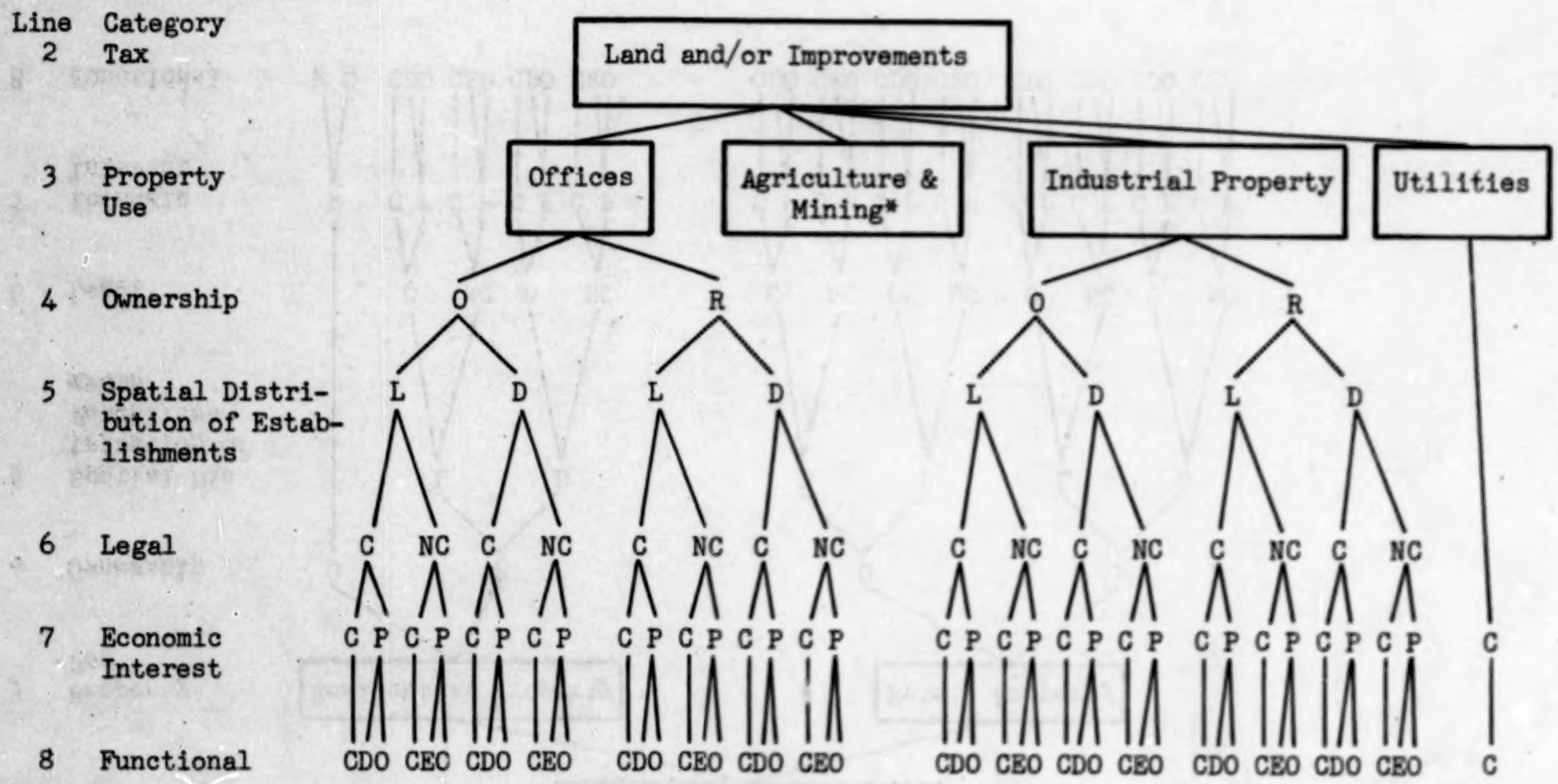

Line
Category
2 Tax
3 Property Use
4 Ownership
5 Spatial Distribution of Establishments
6 Legal
7 Economic Interest
8 Functional
9 Final Spatial Incidence
Land and/or Improvements
Residential Property
Retail Property
O
R
O
R
L
D
L
D
L
D
W
C
NC
C
NC
C
NC
C
NC
C
NC
C
NC
W
C P C P C P C P
C P C P C P C P C P C P C P C P
W O
CDO CEO CDO CEO
CDO CEO CDO CEO CDO CEO CDO CEO
Six Geographic areas

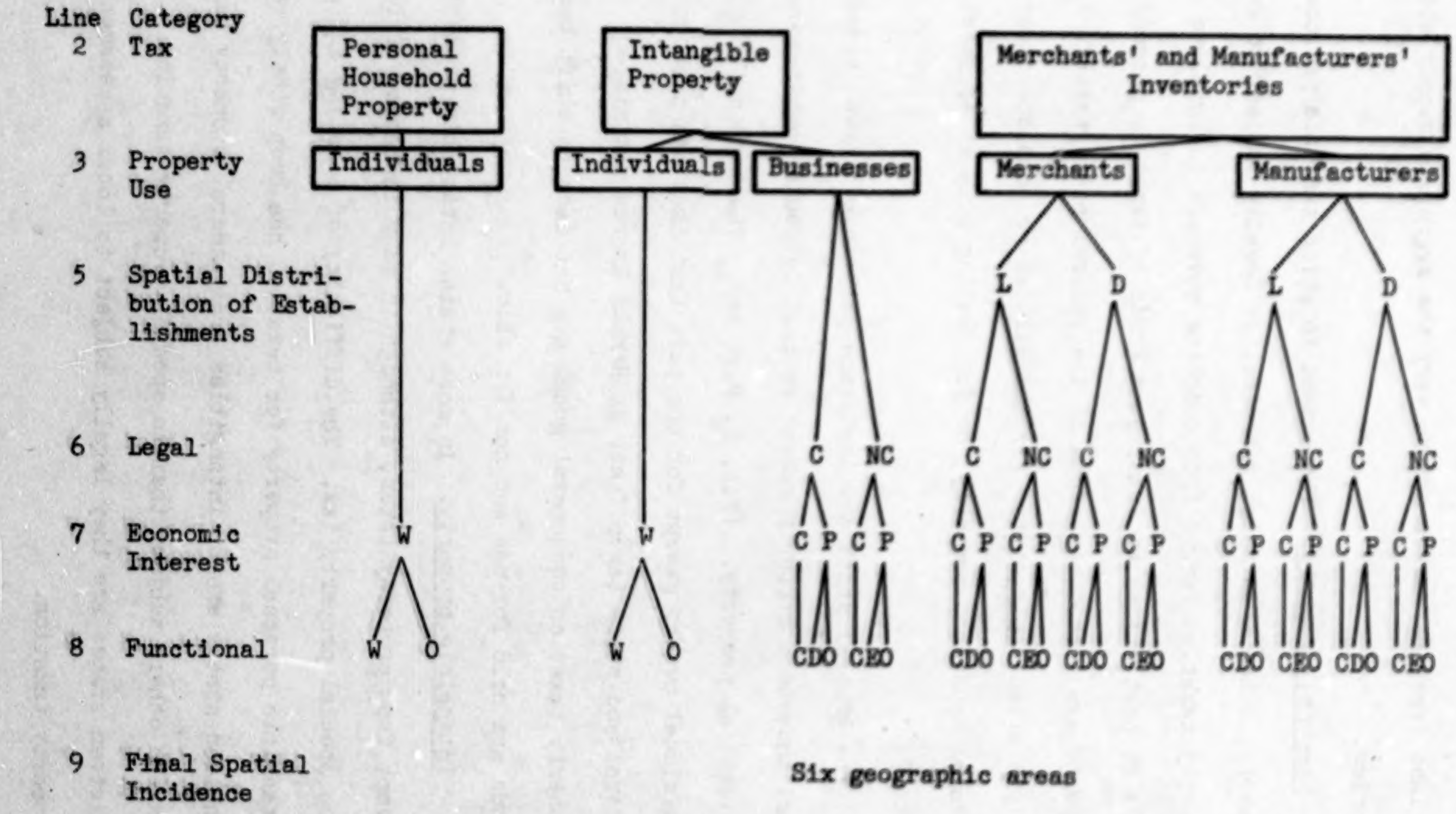
Fig. 4: Part iii



9 Final Spatial Burden Six geographic areas

*The shifting model for Agriculture & Mining Properties is identical to those shown above for Office and Industrial Properties

Fig. 4: Part iv


Line
Category
2
Tax
3
Property Use
5
Spatial Distribution of Establishments
6
Legal
7
Economic Interest
8
Functional
9
Final Spatial Incidence
Personal Household Property
Individuals
W
W O
Intangible Property
Individuals
W
W O
Businesses
C NC
C P C P
CDO CEO
Merchants' and Manufacturers' Inventories
Merchants
L D
C NC C NC
C P C P C P C P
CDO CEO CDO CEO
Manufacturers
L D
C NC C NC
C P C P C P C P
CDO CEO CDO CEO
Six geographic areas

result, land uses shift between functions even though the aggregate supply is fixed. (3) Speculators and individuals may withhold part of the land from the market and so vary the aggregate supply with changes in price.

Personal property. The extent to which tangible personal household property, other than motor vehicles, is legally subject to general property taxation ranges from complete coverage to complete exemption. While in most states at least some kinds of tangible personal household property are within the scope of the general property tax, legal provisions often apply either for the partial or complete exemption of personal household property, or for dealing with it by special property taxes.[4]

The general shift and incidence pattern of taxes levied on personal household property resembles that levied on owner-occupied residential property. (Fig. 4, Part iv). The burden falls on individual owners except for the part that they can pass on through the federal and state tax offset. As Harold Groves has stated, "Personal property taxes on consumers' goods are not easy to shift because these goods are held for use and not for sale."[5]

Intangible property. In most states intangible property is legally exempt from property taxes, although in many instances it is subject to some special property tax. The difficulty of locating and assessing intangible personal property for taxation has been widely recognized. Nineteen states exempt intangibles from general property taxes, while sixteen others subject them to special property taxation. In only thirteen states are they legally subject to local assessment for general property taxation.

Intangible property can be owned by individuals or businesses (Fig. 4, Part iv). In the first case, the shift and incidence patterns are similar to those of taxes levied on personal property. In the second, it is useful to distinguish whether corporate or non-corporate firms own the intangible property (line 6). Lines 7-9 are the same categories as those applying to rental residential property.

Merchants' and manufacturers' inventories. In most states personal property taxes on merchants' and manufacturers' inventories, plus agricultural implements and livestock, comprise the only forms of personal property which are commonly included within the scope of the general property tax.

The incidence pattern of taxes levied on merchants' and manufacturers' inventories is similar to that on commercial property (Fig. 4, Part iv, lines 5-9). Taxes levied on merchants' and manufacturers' inventories enter directly into marginal cost estimates, thereby facilitating shifting of the burden of the tax to consumers.

Empirical Property Tax Incidence Model for Clayton, Missouri

The empirical model is based on the general model but combines or deletes some of its features. This simplification is feasible because of the relatively simple structure of the Clayton community.

In 1959-1960, 2,236 students attended Clayton's six elementary schools and the junior and senior high schools. The average current expenditure, plus debt service, per pupil in ADA, was $1,023.17. During the 1950's and early 1960's, 85 to 89 per cent of the Clayton School

District revenue was raised by the district itself, 9 to 11 per cent by the state of Missouri, 2 to 4 per cent by St. Louis County and about 1 per cent by the federal government (Table 3). Of the revenue raised locally by the Clayton School District in the school year 1959-1960, 88 per cent derived from property taxes and the remainder largely from user charges for lunches, athletic activities, etc. (Table 4). Except for the intangible property tax collected by the state and apportioned back to the Clayton School District, all other taxes are collected by the school district with the aid of the county assessor's office.

The following pages will present empirical estimates applicable to the property tax incidence model illustrated for Clayton for the school year 1959-1960 (Fig. 5). This empirical model reflects the special Clayton situation, with changes in specific elements depending upon the available information. Thus, the Clayton model has four tax impact units (Fig. 5, Part i, line 2). Land and improvements are combined into the real property classification. Although each is assessed separately, these data are not independently totaled nor are they available for properties classified according to residential, retail, or other land uses. The industrial and farm categories are deleted from the empirical model since these land uses are not applicable to Clayton. Taxes raised from locally assessed utilities are of insufficient magnitude to warrant the inclusion of this property category (Table 4). No data for the Clayton School District are available for retail and office properties to indicate occupancy status (Fig. 5, Part ii, line 4).

Real Property Taxes

Property use of tax base (line 3). Tax receipts from residential and commercial property were estimated by the Clayton comptroller. Of

Fig. 5: Part i

Incidence of the General Property Tax

Empirical Model

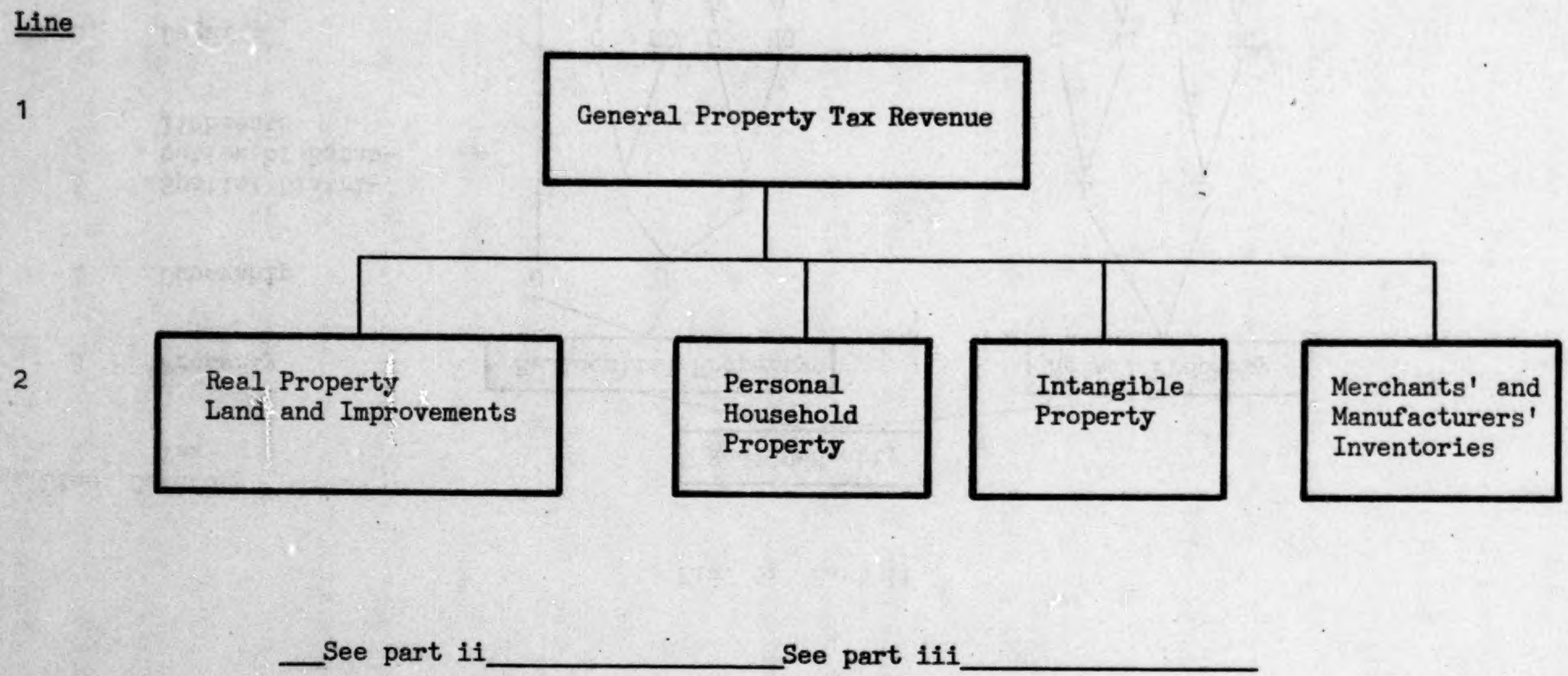
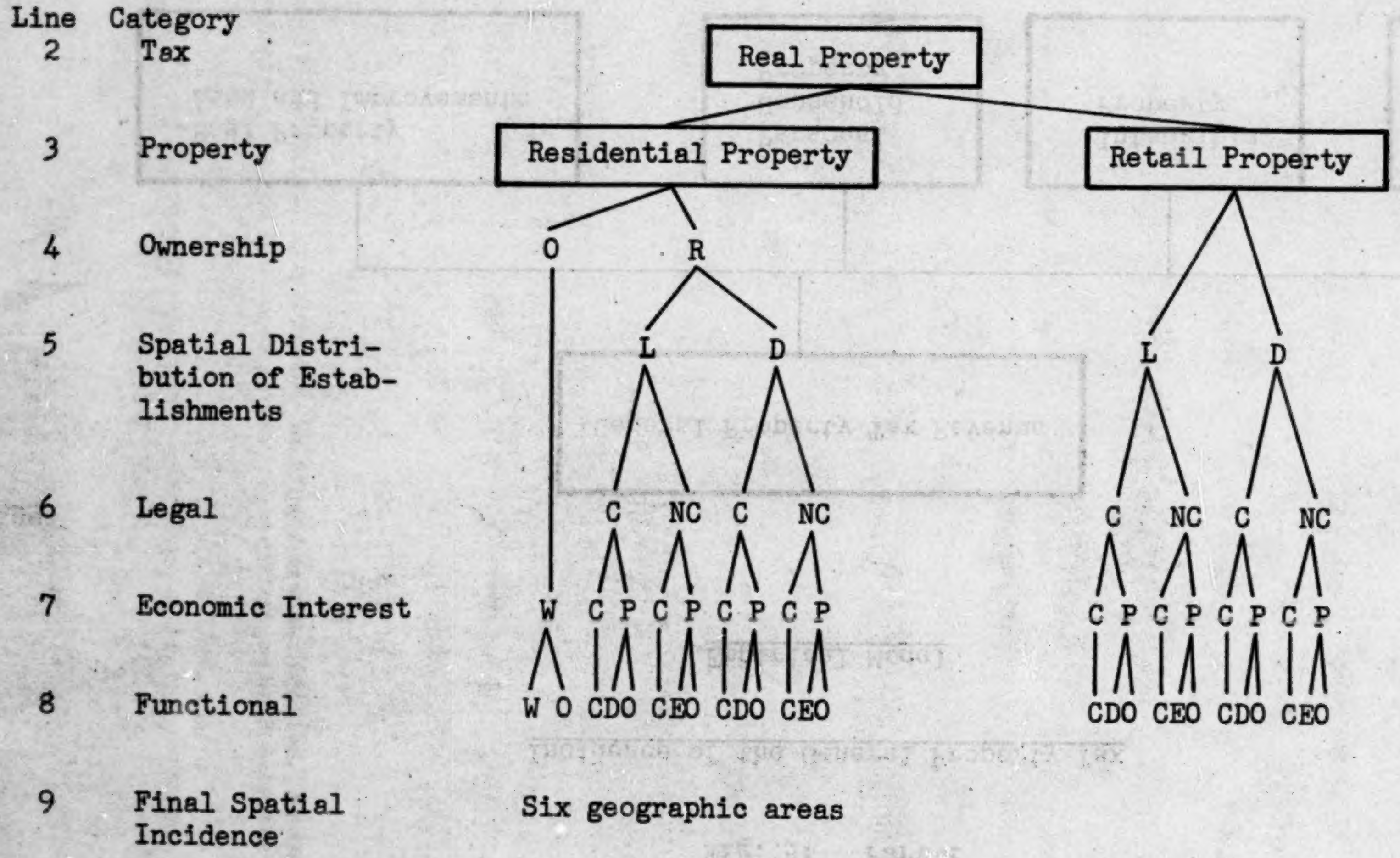

Line
1
General Property Tax Revenue
2
Real Property Land and Improvements
Personal Household Property
Intangible Property
Merchants' and Manufacturers' Inventories
See part ii
See part iii

Fig. 5: Part ii



Line
Category
2
Tax
3
Property
4
Ownership
5
Spatial Distribution of Establishments
6
Legal
7
Economic Interest
8
Functional
9
Final Spatial Incidence
Real Property
Residential Property
Retail Property
O
R
L
D
L
D
C
NC
C
NC
C
NC
C
NC
W
C
P
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C
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C
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P
C
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O
CDO
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CEO
Six geographic areas

Fig. 5: Part iii

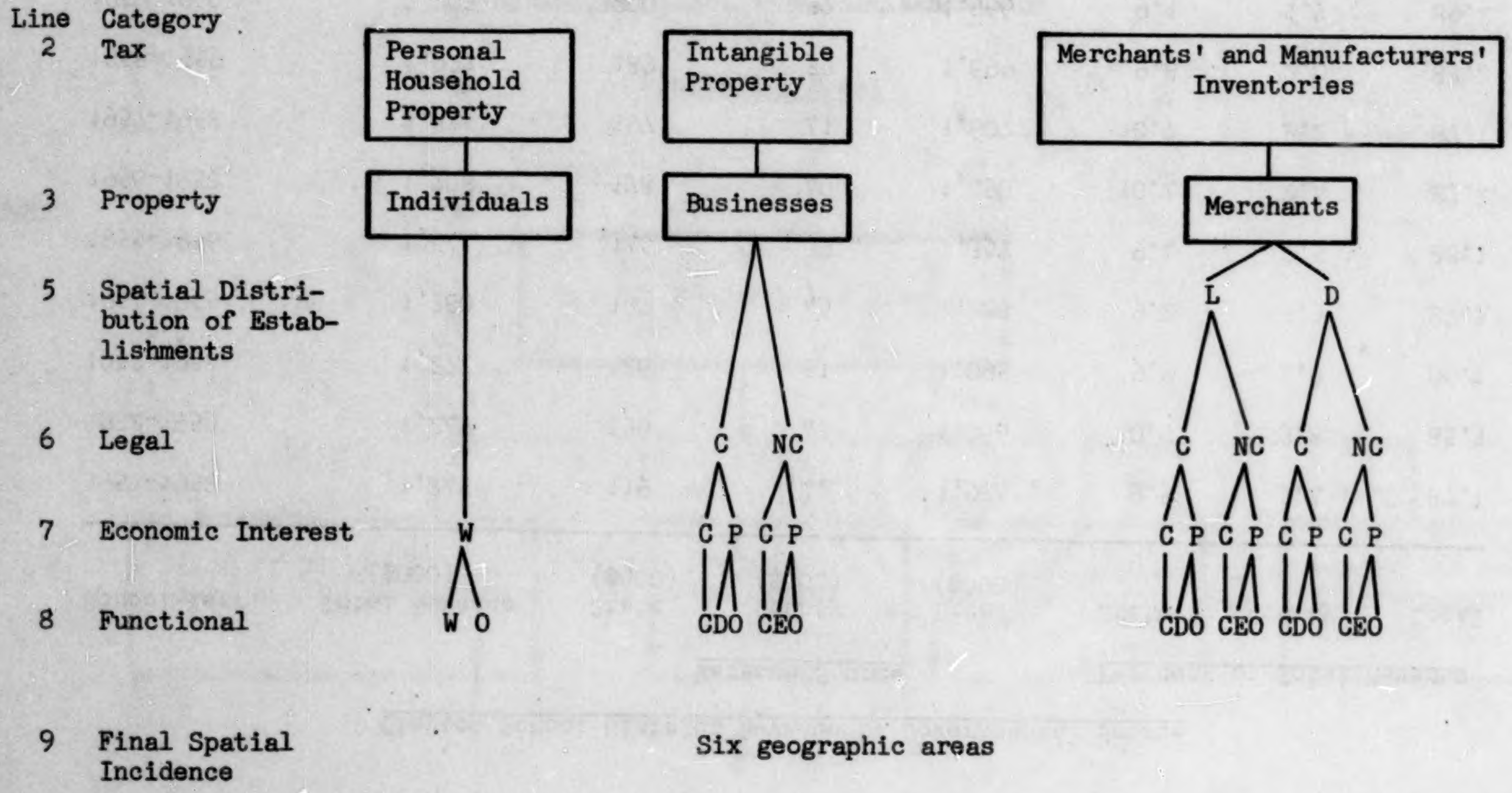


Table 3

Clayton School District Revenue by Governmental Source

School Year	Total Revenue ($000)	Revenue Source State ($000)	County ($000)	Local ($000)	Per cent of Total Revenue State	County	Local
1951-1952	1,245	119	42	1,084	9.5	3.4	87.1
1952-1953	1,249	136	47	1,066	10.9	3.8	85.3
1953-1954	1,272	126	51	1,095	9.9	4.0	86.1
1954-1955	1,380	127	45	1,208	9.2	3.3	87.5
1955-1956	1,541	145	39	1,357	9.4	2.5	88.1
1956-1957	1,708	178	40	1,490	10.4	2.4	87.2
1957-1958	1,845	197	41	1,607	10.7	2.2	87.1
1958-1959	1,927	189	39	1,699	9.8	2.0	88.2
1959-1960	2,203	200	37	1,966	9.1	1.7	89.2
1960-1961	2,287	208	48	2,031	9.1	2.1	88.8

Source: St. Louis County Superintendent of Schools, Annual Reports, 1951-1952 to 1960-1961.

locally collected real property tax revenues, 66 per cent was derived from the residential sector, 34 per cent from commercial properties.[6] Assuming assessed value to be proportionate to floor space in retail and office properties, it was estimated that of the 34 per cent commercial property tax receipts, 36 per cent was retail property and 64 per cent, offices.[7]

Estimated values:

Sector	Per cent
Residential	66.0
Retail	12.2
Offices	21.8
Real Property	100.0

Ownership (line 4). Residential property is reported in the U.S. Census of Housing by rental/owned occupancy status. In 1960 the median value of owner-occupied dwellings in Clayton was $30,100, the median monthly contract rental was $115.[8] Assuming a depreciation period of twenty years, the ratio of imputed owner residential yearly payments to rental payments was found to be 1.09 to 1. This ratio was applied to the Clayton proportions of owned (41 per cent) and rental (58 per cent) dwelling units as derived from the 1959 Land Use Inventory, St. Louis County, Missouri.[9]

Estimated values:[10]

Occupancy	Per cent
Owned	46
Rental	54

Spatial distribution of establishment (line 5). The identification of firms owning property solely within the Clayton School District, and those with holdings both inside and outside the district, was facilitated by a review of the Clayton Business Directory[11] and by interviews with city officials and business leaders. It was estimated that the value of holdings owned by firms with dispersed interests was greater than by

Table 4

Locally Raised Revenue of the Clayton School District, 1959-1960

Source	Dollar Amount	Per Cent of Total
Tax Revenues		
Real Estate	$1,356,118	69.0
Personal Household Property	171,561	8.7
Merchants' and Manufacturers' Inventories	46,278	2.3
Locally Assessed Utilities	1,165	0.1
Intangible Property	104,235	5.3
Total Current Taxes	1,679,357	85.4
Delinquent Taxes	59,592	3.0
Non-Tax Revenue		
Tuition from Non-Resident Students	44,164	2.2
Cafeteria Sales	87,737	4.5
Student Activities	25,548	1.3
Community Services (summer programs, rentals of school facilities)	17,013	0.9
Miscellaneous (primarily rental of facilities to the St. Louis County Special School District)	25,274	2.7
Total Non-Tax Revenues	226,736	11.6
Total Revenue	$1,965,685	100.0

Source: Information provided by the Office of the Assistant Superintendent, Clayton School District, Clayton, Missouri (February 7, 1962) those with solely local interests. A similar estimate was made for retail and office property, with a resultant strengthening of emphasis on the higher value of property held by firms with dispersed interests. For rental residential property, local and dispersed holdings were about equally divided.

Estimated values:

Sector	Per Cent Local	Dispersed
Residential	40	60
Retail	30	70
Offices	30	70

Legal structure of firm (line 6). To determine the corporate/non-corporate characteristic of Clayton property owners, the St. Louis county assessor's listing of corporate property was supplemented by information gained from interviews with persons familiar with business organizations in Clayton. Real estate agents contacted suggested that the corporate form of ownership was prevalent, notably among firms in the retail and office sectors with dispersed holdings.

Estimated values:

Sector	Per Cent Corporate	Non-corporate
Residential-Rental		
Local	50	50
Dispersed	70	30
Retail and Offices		
Local	75	25
Dispersed	90	10

Economic interest of individuals (line 7). The extent to which business firms shift property taxes was examined in three tax shifting studies and subsequently summarized by Elbert Segelhorst and Stanley Berman.[12] These studies of state and local taxation in Michigan,[13] Wisconsin,[14] and Minnesota,[15] provide a basis for the selection of tax shifting proportions. The following statement by Musgrave and Daicoff constituted a point of departure. " . . . we proceed on the basis of the more or less arbitrary assumption that 3/4 of the tax is shifted forward to the consumer with the remainder resting on profits or capital earnings. . . ."[16] We modified this assumption for Clayton for the following reasons. Even though Clayton is a desirable residential community, it is assumed that sufficient competition to decrease the proportion of taxes shifted to consumers (tenants) comes to rental property from the "for sale" market and from alternative apartment facilities in the western section of the city of St. Louis. On the other hand, Clayton occupies a singularly attractive position in the market for office space and enjoys a strong demand for new office facilities. Thus, in the office sector the proportion shifted to consumers is assumed greater than 3/4 of the tax.

Estimated values:

Sector	Per Cent Consumers	Profits or Earnings
Residential-Rental	65	35
Retail	75	25
Offices	80	20

Functional role of individuals (line 9). Net taxable income and the applicable marginal rates for individuals, corporations, and unincorporated firms, determine division of the final burden between these units and other citizens of the nation via the federal offset. The Michigan study suggests that corporations shift 50 per cent through the federal offset and that the other 50 per cent is borne by shareholders; non-corporate firms are estimated to shift 25 per cent through the offset and 75 per cent is borne by earnings recipients.[17] The Wisconsin study utilized similar percentages for corporations.[18] Home owners in Clayton shift 25 per cent through the offset because their incomes place them in that marginal tax bracket.

Estimated values:

Function	Per Cent
Owner-occupant	75
Offset	25
Dividend recipient	50
Offset	50
Earnings recipient	75
Offset	25

Final spatial tax incidence (line 9). In general, economic participation by residents of one area in the economy of another depends upon (inter alia) the relative availability of goods and services in the areas under study, as well as in those that are competing, and economically intervening; on the relative buying power of residents of the first area; and on the relevant distance between the two areas.

Estimates for Clayton acknowledge the wide range of goods, services, and investment opportunities it offers to a large, wealthy population in adjacent communities. Thus, automobiles in the Clayton shopping district were recorded according to the geographic areas of their registration.[19] The movement of vehicles in the entire area was detailed by origin, destination, and purpose.[20] From these studies and subsequent interviews with business and civic leaders of Clayton, a composite estimate was made by function for each sector of the extent of economic participation in dollar volume. The spatial distribution of the federal offset was estimated from the ratio of federal tax obligations of an area measured by (1) income recipients in an area, multiplied by (2) the mean income of the area in 1959, multiplied by (3) the average tax rate applicable to the mean level of income in the area to the federal tax obligations of all citizens in the forty-eight contiguous states.

Estimated values: Table 5 indicates the per cent of participation by function in the economy of Clayton by residents of different geographic areas. For example, 15 per cent of retail sales are estimated to have been made to consumers from Clayton, 70 per cent to those from the rest of the county, 10 and 5 per cent, respectively, to residents of the core city and the rest of the SMSA.

Personal Household Property Taxes

Personal household property taxes are assumed borne by individual taxpayers who can shift part of their burden to the rest of the United States through the offset allowances of the federal income taxes. As in previous cases, shifting to the remainder of the state, through offset allowances of the state income taxes, is assumed negligible. Individual taxpayers shift to the rest of the United States at a rate determined by their marginal tax brackets. Thus, the high income of Clayton residents is assumed to permit 25 per cent shifting of the personal property tax. This coefficient was used in the owned residential section of the real property tax and there appears to be no reason to assume any difference in the shifting of the two taxes.

Intangible Property Taxes

Because of the ease of individual evasion, intangible property taxes are assumed to be paid exclusively by business firms. The composition of intangible properties (stocks, bonds, securities, patents, etc.) suggests that their ownership is predominantly, if not exclusively, among firms occupying office space. It is assumed that occupants of office space shift the intangible property taxes in the same manner as owners of (dispersed) office properties shift the real

Table 5

Coefficients of Participation in the Clayton Economy by Function and Sector for Six Geographic Areas

(in percentages)

SECTOR	FUNCTION[a]		GEOGRAPHIC AREA[b] 1	2	3	4	5	6
Residential	Property owner		100	--	--	--	--	--
Residential	Consumer (tenant)		100	--	--	--	--	--
Residential	Dividend recipient	(L)	30	65	05	--	--	--
		(D)	25	70	05	--	--	--
Residential	Earnings recipient	(L)	40	55	05	--	--	--
		(D)	35	60	05	--	--	--
Retail	Consumer		15	70	10	05	--	--
Retail	Dividend recipient	(L)	25	70	05	--	--	--
		(D)	20	65	05	--	--	10
Retail	Earnings recipient	(L)	40	60	--	--	--	--
		(D)	25	70	05	--	--	--
Office	Consumer	(L)	10	70	10	10	--	--
		(D)	05	65	05	10	05	10
Office	Dividend recipient	(L)	15	80	05	--	--	--
		(D)	15	60	05	05	05	10
Office	Earnings recipient		20	75	05	--	--	--
All Sectors	Offset							

1 : (0.0360)   4 : (0.3408)
2 : (0.5970)   5 : (0.9880)
3 : (0.3654)   6 : (97.6728)

---

a. When different estimates have been made for firms with local or dispersed outlets the designations (L) and (D) have been used respectively.

b. 1 : Clayton School District   4 : Rest of SMSA
2 : Rest of [illegible]. Louis County   5 : Rest of Missouri
3 : City of St. Louis   6 : Rest of United States

property tax. This assumption also attributes to the two groups the same pattern of geographic distribution of owners and consumers, level of income, and legal structure.

Merchants' and Manufacturers' Inventory Taxes

The absence of manufacturing activity in Clayton removes taxes on manufacturers' inventories from consideration. Merchants are assumed to shift taxes on their inventories in the same manner as taxes on real retail property are shifted. The three similar assumptions relevant to the intangible property taxes (see preceding paragraph) also apply in this case.

Implementation of the Empirical Model and Findings

From the structural descriptions of the models of the four property taxes and the coefficient estimates outlined above, it becomes possible to state the percentages of the Clayton School District taxes borne by the six geographic areas previously identified.

Table 6 illustrates the computational process that determines the burdens on individual areas. Before such aggregate burdens can be stated, the burden on each individual area must first be derived. This is ascertained by means of a series of multiplications which yields a statistic that represents the burden on a given area by each separate functional characteristic of economic participation. When such statistics are completed, a summation demonstrates the burden of each tax on each of the six geographic areas. In Table 7 such a summation is presented. Column 1 of Table 7 indicates that nearly one-half of the real property tax is spilled out of Clayton. One-quarter of the personal household property tax (column 2) is spilled out through the federal offset with small burdens accruing to nearby areas. On the other hand, from 85 to 95 per cent of the merchants' and manufacturers' inventories and the intangible property taxes are spilled out of Clayton (columns 3 and 4).

To obtain an overall view of the distribution of Clayton's property tax burden spillouts, the data for each tax is weighted by the relative importance of the tax. The estimated contributions by each of these taxes to total property tax collections is shown in Table 8 . Clearly, with over 80 per cent of the revenue coming from real property taxation, the spatial burden pattern of that tax will dominate the overall property tax burden pattern. Applying the percentages of Table 8 to the individual taxes of Table 7 yields the final spatial incidence of locally raised tax revenues for the Clayton School District in the year 1959-1960. Table 9 indicates that nearly one-half of the burden of all property taxes levied by Clayton was spilled out. Of this figure, over 50 per cent was a burden to residents of St. Louis County. Less than one per cent was a burden to residents of the rest of the state outside the metropolitan area.

Applying the percentages of burden experienced by each area from Clayton's property taxation (Table 9 , Column 5) to the amount of direct operating costs financed by local property taxes (Table 2), a monetary estimate of burden can be made. Table 10 reveals that of the nearly $1.6 million of locally financed direct operating costs, Clayton residents realized a burden of almost $0.8 million, with nearly the same amount borne by residents of other areas. Residents of the rest of St. Louis County bore over $0.4 million, which was half of the amount

Table 6

Clayton School District Intangible Property Tax Model

Category						
Tax	Intangible Property Tax Revenue 100 (100.00)					
Property	Business Firms 100 (100.00)					
Legal	Corporate 90 (90.00)			Non-Corporate 10 (10.00)		
Economic Interest	Consumer 80 (72.00)	Profit 20 (18.00)		Consumer 80 (8.00)	Profit 20 (2.00)	
Functional	Consumer 100 (72.00)	Dividend Recipient 50 (9.00)	Offset 50 (9.00)	Consumer 100 (8.00)	Earnings Recipient 75 (1.50)	Offset 25 (0.50)
Spatial Incidence						
Clayton School Dist.	05 (3.60)	15 (1.35)	-- (--)	05 (0.40)	20 (0.30)	-- (--)
Rest of St. Louis County	65 (46.80)	60 (5.40)	-- (--)	65 (5.20)	75 (1.13)	-- (--)
City of St. Louis	05 (3.60)	05 (0.45)	-- (--)	05 (0.40)	05 (0.07)	-- (--)
Rest of SMSA	10 (7.20)	05 (0.45)	-- (--)	10 (0.80)	-- (--)	-- (--)
Rest of Missouri	05 (3.60)	05 (0.45)	-- (--)	05 (0.40)	-- (--)	-- (--)
Rest of U.S.	10 (7.20)	10 (0.90)	100 (9.00)	10 (0.80)	-- (--)	100 (0.50)

Table 6

Part ii

Figures without brackets represent per cent of shifting from higher category.

Figures within brackets represent per cent of total burden by category; within a single category all bracket figures equal 100.00.

Example:

To determine the burden of the Clayton intangible property tax upon dividend recipients residing in St. Louis the following steps are taken:

1) multiply the percentage of the intangible property tax which falls upon business firms by the total tax (100 x (100.00) = (100.00))
2) multiply the corporate percentage by the portion of the intangible property tax borne by business (90 x (100.00) = (90.00))
3) multiply the portion of taxes borne by profits of the corporations paying the tax (20 x (90.00) = (18.00))
4) multiply the portion of taxes borne by dividend recipients by the taxes borne by profits (50 x (18.00) = (9.00))
5) multiply the portion of dividends received by St. Louis residents of total dividends by the burden upon dividend recipients (05 x (9.00) = (0.45))

Thus for each $100 collected by the Clayton intangible property tax, a burden of 45¢ falls upon dividend recipients residing in St. Louis.

Note: For simplicity, it is assumed in this example that the burden of the federal offset rests entirely upon residents of the rest of the United States.

Table 7

Burden of the Clayton School District Property Taxes by Area and Type of Property (in percentages)

Geographic Area	1 Real Property	2 Personal Household Property	3 Intangible Property	4 Merchants' and Manufacturers' Inventories
1. Clayton School District	51.57	75.01	5.65	14.43
2. Rest of St. Louis County	24.45	0.15	58.59	61.42
3. City of St. Louis	2.66	0.09	4.55	8.14
4. Rest of SMSA (St. Louis, Mo.-Ill.)	2.33	0.08	8.48	3.78
5. Rest of Missouri	0.83	0.25	4.54	0.11
6. Rest of United States	17.17	24.42	18.19	12.12
Total	100.00	100.00	100.00	100.00

Table 8

Tax Revenue of the Clayton School District for the School Year 1959-1960 by Type of Property (in percentages)

Property Tax	Per Cent of Total Tax Receipts
Real Property	80.82
Personal Household Property	10.22
Intangible Property	6.21
Merchants' and Manufacturers Inventories	2.75
Total	100.00

Source: Table 4 above

Table 9

Final Incidence of the Clayton School District Property Tax Revenues 1959-1960 by Areas and Type of Property (in percentages)

	Property Tax				
	1	2	3	4	5
Geographic Area	Real Property	Personal Household Property	Intangible Property	Merchants' and Manufacturers' Inventories	Total
1. Clayton School District	41.68	7.66	0.35	0.40	50.10
2. Rest of St. Louis County	20.57	0.01	3.64	1.69	25.91
3. City of St. Louis	2.15	0.01	0.28	0.22	2.66
4. Rest of SMSA	1.88	0.01	0.53	0.11	2.53
5. Rest of Missouri	0.67	0.02	0.28	--	0.97
6. Rest of United States	13.87	2.50	1.13	0.34	17.83
Total	80.82	10.22	6.21	2.75	100.00

borne by Clayton residents themselves.

Spillins

Through the tax shifting mechanism the residents of Clayton share the burden of property taxes raised by local, intermediate, and state governments with other citizens throughout the United States. In 1957-1958 these governmental units raised $22.5 billion for the support of public education in the 48 states and the District of Columbia. Of this amount 54.6 per cent, or $6.3 billion was derived from property taxes.[21]

The spatial incidence tax model demonstrates that Claytonians, as consumers of goods produced in other areas and as customers and owners of firms located in other areas, contribute to the education of children in adjacent school districts as well as in those all across the nation. Data availability necessitates some modifications in the model, but the general structural framework is suitable. Each of the five areas is analyzed and coefficients are estimated for each line of the model. Estimates of spillins to Clayton, therefore, are computed in the same manner as its spillouts, as described above. However, there are the following departures from this methodology and from the data source problems.

Tax category (line 2). Spillin estimates were made for real and personal property taxes. In the five areas of study, real property assessments ranged from 71.1 to 82.8 per cent of all properties subject to the general property taxes.[22]

Property use category (line 3). The retail and office sectors of the spatial incidence model were aggregated into a single commercial sector. The absence of local industry, agriculture and mining activities leads to their omission from the empirical model for Clayton

Table 10

Final Incidence of the Clayton School District Direct Operating Costs Financed by Local Property Taxes, for the School Year 1959-1960, by Area ($000)

Geographic Areas	Amount of Burden
1. Clayton School District	790.7
2. Rest of St. Louis County	408.9
3. City of St. Louis	42.0
4. Rest of SMSA	39.9
5. Rest of Missouri	15.3
6. Rest of United States	281.4
Total	1,578.3

Note: Column total does not add because of rounding.

(Fig. 5). These sectors are present in the five areas considered for the spillin portion of the empirical work and are therefore included as indicated in the theoretical model (Fig. 4).[23]

Spatial distribution of outlets category (line 5). The distinction between firms with outlets in only one taxing jurisdiction and those with dispersed outlets was deleted from the model because of the lack of empirical data.

Legal category (line 6). Data published by the Bureau of the Census for all firms collectively, and for corporations alone, provide an indication of the relative weights appropriate for the corporate and non-corporate classifications.[24]

Economic interest category (line 7). The inclusion of industry and land-oriented activities (agriculture and mining) in the property category (line 3) required new shifting coefficients, specifically for these sectors. Industrial firms were assumed to shift 50 per cent to consumers, with 50 per cent falling on profits because these property taxes are a common element of cost among competitors in national markets. Firms that are able to administer prices probably augment this percentage. Agricultural firms were assumed to absorb all property taxes out of profits. This is likely to overstate the case. In agriculture, the shiftable portion would be much less because of the greater importance of land rent; the non-migratory character of important factors of production; and the lack of power to administer prices. The political power of farmers to negotiate price supports is an offsetting force tending to increase the shiftable portion of these taxes.

Economic function category (line 8). Date on average and marginal tax rates, in some instances by type of business, are published annually by the Internal Revenue Service.[25]

Estimates of the spillins of burdens on Clayton residents from the direct operating costs financed by local property taxes of all other areas are indicated in Table 11. Although the percentage of total tax burden (column 2) of any one area shifted to Claytonians is minor, the magnitude of the costs (column 1) leads to major spillins to Clayton (column 3). Thus, Clayton residents realized a burden of over $2.6 million of the direct operating costs of education provided in other areas and financed by the local property taxes of those areas in 1959-1960. Half of this spilled-in burden came from the rest of the United States. Another one-third was spilled in by the three areas which, with Clayton, constitute the St. Louis metropolitan area.

Table 12 compares the spillouts from Clayton of direct operating costs financed by local property taxes with the corresponding spillins from other areas. While Clayton spilled out over three-quarters of a million dollars in cost burdens, there was a spillin in excess of $2.6 million. Clayton's net position shows a spillin of more than $1.8 million. Only with respect to the rest of St. Louis County did Clayton have a net spillout; with all other areas there was a net spillin.

Adding the $891,000 of locally financed direct operating costs borne by Claytonians, of education they provided (Table 10), to the net cost spillin of $1,836,000 resulting from education provided by other areas, the total locally financed direct operating cost burden to the residents of this suburban community was $2,727,000 for the school year 1959-1960.

Table 11

Direct Operating Costs Financed from Local Property Taxes and the Burden Shifted to Clayton, 1959-1960, by Area

($000)

Area	(1) Direct Operating Cost Financed from Local Property Taxes	(2) Percentage Shifted to Clayton Residents	(3) Spillin of Burden to Clayton Residents
2. Rest of St. Louis County	$33,130.7	1.2223	$405.0
3. City of St. Louis	24,904.6	1.3236	329.6
4. Rest of SMSA	25,366.8	0.6955	176.4
5. Rest of Missouri	90,950.0	0.3717	338.1
6. Rest of United States	6,773,299.3	0.0203	1,375.0
Totals	$6,947,651.4		$2,624.1

Table 12

Spillovers of Property Tax Burdens, by Area

($000)

Area	Spillout from Clayton (+)	Spillin to Clayton (-)	Net Spill-over
2. Rest of St. Louis County	$408.9	$405.0	$ + 3.9
3. City of St. Louis	42.0	329.6	-287.6
4. Rest of SMSA	39.9	176.4	-136.5
5. Rest of Missouri	15.3	338.1	-322.8
6. Rest of United States	281.4	1,375.0	-1,093.6
Totals	$787.6	$2,624.1	$-1,836.5

Modifications of the Empirical Model

The results presented in the preceding section were derived from specified assumptions and data relevant to the Clayton School District. However, the model developed for the estimation of spillouts and spillins is of more general applicability and can yield results under a wide variety of conditions. For example, other conditions could be stipulated for the Clayton School District or for an entirely different community and alternative spatial property tax burdens estimated. Thus, this model lends itself to a sensitivity analysis which assumes extreme lower and upper boundaries for various factors affecting spillover and estimates their actual effects.

The following discussion will engage in such a sensitivity analysis, in which the new assumptions are built around existing conditions in Clayton.

Instead of making our analysis relative to all property taxes, the emphasis will be on real property taxes. This will greatly facilitate our task. There is evidence that the results of this simplified effort will not differ greatly from those that would be obtained if all property taxes were analysed. A perusal of Tables 7 and 8 reveals that the final geographic incidence resulting from the real property tax (Table 7, column 1) shows only minor differences from that of all property taxes (Table 8, column 5). Two factors contribute to this close relation: the real property tax accounts for nearly 81 per cent of all property taxes collected in Clayton; and each of the three remaining property tax types is closely related to one of the three major portions of the real property tax model. The pattern of personal household property is related to owned-residential property, intangible property to dispersed office property, and merchants' and manufacturers' inventories to dispersed retail property. The overall property tax model bears close resemblance to the real property tax model because of the repetition of similar aspects, even though in slightly abbreviated form, and reinforces the initial dominance of the real property tax. Therefore, modifications introduced into the real property tax shifting model will tend to similarly influence the total property tax incidence pattern. The following cases apply to the real property tax although their extension to the other three property taxes appears to have but minor influence on the final spatial tax burden. Changes introduced in the initial model are assumed to leave unaffected all relationships not explicitly altered.

Relative Importance of the Real Property Categories

A change in the structure of the Clayton community can be reasonably postulated which would increase the relative positions of the retail and office sectors while effecting a decline in the residential sector. Continued expansion of the retail and office areas and conversion of residential land to office use, coupled with the devaluation through time of current residential properties, could in fact result in such a new posture of Clayton's economic life.

If the contribution to total real property revenue were 35 per cent residential, 25 per cent retail, and 40 per cent offices (Table 13, Case 1A), compared to the 1959-1960 percentages of 66, 12.2 and 21.8 respectively, we would expect a decline in the burden on Clayton residents and on the rest of the nation where much of the residential property tax is shifted through the offset from owner occupied property. Residents of St. Louis, the rest of St. Louis County, the rest of the SMSA, and the rest of Missouri are in greater proportion as consumers and owners in the office sector of Clayton than in the residential.

On the other hand, an increase of residential property to 80 per cent of real property values and a decrease of the retail and office sectors to 15 and 25 per cent, respectively (Table 13, Case 1B), will produce results quite different from those obtained in Case 1A, i.e., the burden realized by Clayton residents will increase. The extent of changes in real property tax burdens resulting from these differences in the property category may be noted by a comparison of lines 2 and 3 with line 1 of Table 13.

Relative Importance of Real Property Ownership

The proportion of owner occupied residential property in the community will influence the burden on local residents according to the difference between the coefficient that determines the burden on the owner (derived from his income bracket) and the coefficient that determines the burden on tenants (derived from the supply and demand elasticities). In the initial model the owner was assumed to bear 75 per cent of the tax, shifting 25 per cent to the federal offset. In rental property, the tenant was assumed to bear 65 per cent of the tax. A shift from rented to owned quarters would then increase the burden upon local residents. In rented property, as a result of tax offset, the burden that is not shifted to tenants is borne by owners, residing in various areas, and by residents of the rest of the United States. This dispersion of burden in the rented property sector increases the burden on the rest of the United States when the rented sector becomes less important in the model.

To illustrate these effects, owner occupied property was increased from 46 per cent to 75 per cent of the total residential property:

Table 13

Burden of the Clayton School District Real Property Tax by Area (in percentages) for Different Property and Ownership Category Coefficients

	Geographic Area					
	1	2	3	4	5	6
Model Variant	Clayton School District	Rest of St. Louis County	City of St. Louis	Rest of SMSA	Rest of Missouri	Rest of United States
1. Initial Model	51.57	25.45	2.66	2.33	0.83	17.17
Change in Property Category*						
2. Case 1A	31.99	42.01	4.49	4.28	1.23	16.00
3. Case 1B	61.06	17.92	1.94	0.99	0.15	17.94

*Property Category Coefficients (per cent)

	Initial Model	Case 1A	Case 1B
Residential	66.0	35.0	80.0
Retail	12.2	25.0	15.0
Office	21.8	40.0	5.0

Table 13

Part ii

	Geographic Area					
	1	2	3	4	5	6
	Clayton School District	Rest of St. Louis County	City of St. Louis	Rest of SMSA	Rest of Missouri	Rest of United States
Change in Ownership Category**						
4. Case 2A	52.21	22.84	2.40	2.28	0.67	19.60
5. Case 2B	51.09	27.17	2.75	2.28	0.67	16.04

** Ownership Category Coefficients (per cent)

	Initial Model	Case 2A	Case 2B
Owned	46.0	75.0	25.0
Rented	54.0	25.0	75.0

the rented residential property sector was decreased correspondingly from 54 to 25 per cent (Case 2A). Comparison of lines 1 and 4, Table 13, indicates the magnitude of the increased burdens upon Clayton and the rest of the United States. In the rest of St. Louis County and St. Louis City, the burden has declined. Conversely, a shift from owned to rented (Case 2B) yields opposite results (compare lines 1 and 5, Table 13). In both instances no change in the burden on either the rest of the SMSA or Missouri is recorded; neither of these areas participate in the Clayton residential sector (see Table 5).

Relative Importance of Spatial Distribution of Establishments

The initial model proposes that 30 to 40 per cent of the firms in Clayton have holdings in the local district only. As the Clayton economy becomes more widely related to other major business centers, a process well under way at present, firms with widely dispersed holdings become even more prevalent.

The following modifications were introduced:

Sector	Local/Dispersed Coefficients	
	Initial Model	Modification
Residential	40/60	20/80
Retail	30/70	10/90
Offices	30/70	10/90

Comparison of lines 1 and 2 of Table 14 indicates only minor changes in the tax burden distribution. Higher ownership representation in the rest of the SMSA, Missouri, and the United States, assumed in dispersed firms, leads to increased burdens in these areas. Lower ownership

Table 14

Burden of the Clayton School District Real Property Tax by Areas (in percentages) with Specific Changes Introduced

	Geographic Area					
	1	2	3	4	5	6
Modified Category	**Clayton School District**	**Rest of St. Louis County**	**City of St. Louis**	**Rest of SMSA**	**Rest of Missouri**	**Rest of United States**
1. Initial Model	51.57	25.45	2.66	2.33	0.83	17.17
2. Spatial Distribution of establishments	51.21	25.08	2.42	2.30	0.86	18.13
3. Legal	51.07	24.93	2.57	2.29	0.68	18.46
4. Economic Interest	40.01	27.05	2.43	1.48	0.53	28.50
5. Functional	55.13	26.65	2.69	2.29	0.68	12.56
6. Final Spatial Incidence	50.60	19.81	3.43	1.80	2.59	21.77

representation in dispersed firms by residents of Clayton, the rest of St. Louis County, and St. Louis City leads to decreased burdens.

Relative Importance of Corporate Versus Non-Corporate Enterprises

Incorporation of enterprises often accompanies their growth. Similarly, major real estate undertakings tend to be associated with corporate firms. To indicate the effects of increased corporate ownership of Clayton property, the following coefficients were introduced:

Sector	Corporate/Non-Corporate Coefficients	
	Initial Model	Modification
Residential		
Local	50/50	
Dispersed	70/30	85/15
Retail		
Local	75/25	
Dispersed	90/10	90/10
Offices		
Local	75/25	
Dispersed	90/10	100/0

With the same abilities to shift tax burdens to consumers, firms of each legal form will differ, either in the shifting to owners, or through the federal offset to the rest of the nation, or in the geographic distribution of consumers and owners. The initial model assumes that corporations can shift 50 per cent of the tax through the federal offset, while unincorporated firms, in lower marginal tax brackets, are assumed to shift 25 per cent through the offset. Clearly, an increase in corporations leads to an increase in the burden of local taxes upon the rest of the United States. In the initial model both consumers and owners of incorporated firms are assumed to be more widely distributed. An increase in corporations would then decrease the burden of local taxes upon the Clayton School District, the rest of St. Louis County, and St. Louis City, increasing the burden upon more distant areas. The combined effect of these two aspects of the increase in emphasis upon corporations can be noted by comparing lines 1 and 3 of Table 14. Once again we find that the changes are of minor consequence.

Relative Importance of the Economic Interest Category

The division of the property tax burden between consumers and profits in the initial model is founded upon estimates of a similar study made of Michigan's taxes, adjusted for the Clayton market position. By modifying this category to the extent that the relative position of Clayton declines as other areas offer competitive facilities, new shifting assumptions are offered which postulate greater demand elasticities and hence greater burdens upon profits. The shifting coefficients are:

Sector	Consumers/Profits Coefficients	
	Initial Model	Modification
Residential	65/35	25/75
Retail	75/25	35/65
Offices	80/20	50/50

These coefficients suggest that office property in Clayton is in greater demand than retail property, which in turn is in greater demand than residential property. Or, the ability to substitute alternative office properties in other areas for Clayton facilities is less than the substitutive characteristics of alternative residential properties for those offered in Clayton.

Three elements contribute to an increase in the burden on the rest of St. Louis County and the United States as a result of the increased burden on profits. First, the geographic distribution of rental residential property owners includes the Clayton School District, the rest of St. Louis County, and St. Louis City, while consumers (tenants) reside exclusively in the Clayton School District; the importance of the consumer to rental residential sector (35.64 per cent of total real property tax revenue) is greater than that of any other sector and the magnitude of the change in shifting coefficients (from 65 per cent to 25 per cent) is relatively greater than the change in any other sector. Second, in the initial model residents of St. Louis City, the rest of the SMSA, and Missouri generally predominate as consumers in Clayton rather than as owners of Clayton property, and those in the rest of St. Louis County and the United States, as owners rather than as consumers. Third, an increase in the burden on profits increases the burden on the rest of the United States: firms may offset taxes paid directly to local governing bodies while consumers bear the real property tax indirectly through price increases, whereby the tax becomes indistinguishable for offsetting purposes. Comparison of lines 1 and 4 of Table 14 reveals the magnitude of the effects of the increased tax burden upon profits.

Relative Importance of the Functional Category

The initial model assumes high taxable incomes for home owners and firms in Clayton. Should they decline, for example, due to increased numbers of dependents, increased deductible expenses, lower gross incomes, or lower marginal tax rates, the burden of local real property taxes on the rest of the United States would lessen, while the burdens on all other areas would rise. Below are presented the previously assumed shifting coefficients for home owners, dividend and earnings recipients, and indirect (through the federal offset) contributors, together with the new coefficients, reflecting lower taxable incomes or marginal rates.

Functional Role		Shifting Coefficients of the Functional Category	
		Initial Model	Modification
Residential Owners	Property Owner	75	85
	Indirect Contributor	25	15
Corporate Firms	Dividends Recipients	50	60
	Indirect Contributor	50	40
Non-Corporate Firms	Earnings Recipient	75	85
	Indirect Contributor	25	15

The burden on consumers is unaltered by these changes. With the initial assumptions of 65 to 75 per cent of the tax shifted to consumers, except on owned residential property, the total changes in the geographic distribution of the tax burden (compare lines 1 and 5, Table 14) are of smaller magnitude than we could expect with less shifting to consumers. The greatest divergence, as anticipated, appears in the burden on the rest of the United States. The absolute decline of 10 percentage points in the offset rates yields over a 25 per cent relative decline in the burden on the rest of the nation.

Relative Importance of the Final Spatial Incidence Category

Throughout the above discussion of changes in the initial real property tax model, frequent reference has been made to the importance of the geographic distribution of consumers and owners. The extent of voluntary participation of residents of areas outside a given school district will determine the spatial spillover of local taxes.

With a greater concentration of major retail and office facilities in the Clayton business district, and an increase in major apartment buildings, the economic participation of non-Claytonians may be expected to rise. Just as Clayton may take on more importance as a center of investment opportunities, drawing capital from an ever wider area, it may also increase as a center of services for an expanded area. These changes are reflected in Table 15, which is comparable to Table 5 of the initial model.

Comparison of lines 1 and 6 of Table 14 reveals the extent of decrease in the tax burden on Clayton, remaining St. Louis County, and SMSA residents resulting from the decrease in emphasis on their participation in Clayton's economy. Likewise, the noticeable increases in the remaining three areas are the result of greater emphasis on their respective involvement in Clayton's economy. These changes in the distribution of the real property tax burden would serve to amplify or subdue the effects noted from the introduction of new coefficients in the preceding sections. The magnitude of the tax burden on any single area ultimately depends upon the participation of its residents in the economy of the area under study.

Summary

In the above sections we have examined the effects of various modifications of individual categories which compose the real property tax model. Frequently the deviation in the burden on each area from the initial model was small in magnitude. However, the significant monetary magnitudes involved suggest that even minor percentage deviations can be relevant.

Table 16 summarized the extreme percentage burdens on each area resulting from the modifications discussed above. Inspection of Table 16 reveals that with differing conditions in the real property tax model, the burden on any given area has been varied by factors ranging from 2 to 17. In dollar terms the magnitudes vary from about $33,000 to $395,000.

These modifications, applied only to the spillout of real property taxes from Clayton, could be applied similarly to the spillin of real property taxes to Clayton. In themselves, the spillout modifications would alter the net spillover position of Clayton vis-a-vis the other five geographic areas. Table 17 applies the monetary spillout results of Table 16 to the spillin magnitudes of Table 12. In Table 17 we note the extreme net spillover results obtained from the modifications of the spillout model, the spillin model remaining unchanged. In only one case (the rest of the St. Louis County) would the introduction of the modification yield a change from a net spillin (a negative sign) to a net spillout (a positive sign). However, we might well have anticipated major changes in the net relations between Clayton and other areas had our modifications been less modest in magnitude, applied to several categories simultaneously, or not restricted to the spillout model.

Table 15

Modified Coefficients of Participation in the Clayton Economy by Function and Sector for Six Geographic Areas (in percentages)

Sector	Function	Geographic Area*					
		1	2	3	4	5	6
Residential	Property Owner	100	--	--	--	--	--
Residential	Consumer (tenant)	100	--	--	--	--	--
Residential	Dividend Recipient	20	35	10	--	05	30
Residential	Earnings Recipient	30	65	05	--	--	--
Retail	Consumer	15	65	10	--	05	05
Retail	Dividend Recipient	15	35	05	--	05	40
Retail	Earnings Recipient	25	70	05	--	--	--

*1 : Clayton School District
2 : Rest of St. Louis County
3 : City of St. Louis
4 : Rest of SMSA
5 : Rest of Missouri
6 : Rest of United States

Table 15

Part ii

Sector	Function	Geographic Area*					
		.1	.2	.3	.4	.5	.6
Office	Consumer	05	50	10	10	10	15
Office	Dividend Recipient	10	25	05	03	07	50
Office	Earnings Recipient	25	70	05	—	—	—
All Sectors	Offset	—	—	—	—	—	100

Note: This table is comparable to Table 5 in which the coefficients of participation for the initial model were presented. No distinction is made above for local and dispersed firms. The entire amount of the offset is assumed borne by residents of the rest of the United States.

Table 16

Burden of the Clayton School District Property Taxes, Extreme Results Obtained from Different Modifications of the Initial Model, by Area

In Percentages

Geographic Area	Low	Initial Model	High
1. Clayton School District	31.99	51.57	61.06
2. Rest of St. Louis County	17.92	25.45	42.01
3. City of St. Louis	1.94	2.66	4.49
4. Rest of SMSA	0.99	2.33	4.28
5. Rest of Missouri	0.15	0.83	2.59
6. Rest of United States	12.56	17.17	28.50

In Dollars for the School Year 1959-1960
($000)

Geographic Area	Low	Initial Model	High
1. Clayton School District	434.2	700.0	828.8
2-6. Total Shifted to Other Areas	923.1	657.3	528.5
Total	1,357.3	1,357.3	1,357.3
2. Rest of St. Louis County	243.2	345.4	570.2
3. City of St. Louis	26.3	36.1	60.9
4. Rest of SMSA	13.4	31.8	58.1
5. Rest of Missouri	2.0	11.3	35.2
6. Rest of United States	170.5	233.0	386.8

Note: The figures presented for areas 2 through 6 are derived from different model variants and are not additive.

Table 17

Net Spillovers of Real Property Taxes, Extreme Results Obtained from Modifications of the Clayton Spillout Model, by Area

($000)

Geographic Area	Low	Initial Model	High
1. Clayton *vis-à-vis* areas 2 through 6	-556.2	-822.2	-950.8
2. Rest of St. Louis County	- 45.8	+ 54.9	+281.2
3. City of St. Louis	-195.8	-186.7	-161.2
4. Rest of SMSA	- 87.9	- 70.5	- 43.2
5. Rest of Missouri	-216.7	-209.5	-183.5
6. Rest of United States	-477.7	-410.4	-261.4

Note: A positive sign indicates a net spillout from Clayton. A negative sign indicates a net spillin to Clayton.

Chapter IV

OPERATING COSTS FINANCED BY STATE PERSONAL INCOME TAXES

A significant proportion of the operating cost of public education provided by local school districts in the United States is financed by state levied personal income taxes. About 39.4 per cent of total public school revenue was raised from state tax sources in 1959-1960.[1] Personal and corporate income taxes comprised approximately 20 and 10 per cent, respectively, of total 1960 state sales, excise, and income tax collections. Sales, excise, and income taxes in 1960, in turn, accounted for about 88 per cent of total state tax revenue sources, excluding taxes earmarked for highway purposes.[2] Thus, personal income taxes currently account for about 8 per cent of the tax revenue used to finance the direct cost of public education in the United States.

The importance of the state personal income tax as a revenue source for the support of public education, however, varies widely in the 34 states that levied such a tax in 1961. In 1957-1958 the per cent of public school revenue raised from state tax sources ranged from a high of 94 per cent in Delaware, to a low of 7 per cent in Nebraska; also in 1960 the per cent of personal income taxes of total major tax revenue collections varied from a high of 81 per cent in Oregon, to a low of less than 4 per cent in Louisiana.[3]

Shifting and Incidence of the Personal Income Tax

Most economists have agreed that the personal income tax rests primarily on the recipient of the income, and more precisely, also on his family and possibly on others he does or might help. This traditional conclusion has been popularly and professionally challenged, however, with the introduction of both short-run and long-run considerations, in which a partial equilibrium analysis appears appropriate for the former and a general equilibrium analysis is required for the latter. State personal income taxes, as opposed to a national tax, are apparently more readily shifted under both short-run and long-run considerations because of greater opportunity for migration to tax-free or lower taxing areas. Let us examine this supposition and try to assess its validity

One of the short-run elements that might lead to some shifting of the burden of a personal income tax is the change in supply (or demand) of labor or of other productive resources. The tax both reduces the income that remains for the individual's disposition and the attraction of work for compensation in relation to his other uses of time. The individual may therefore display less work motivation or direct his efforts towards pursuits yielding non-taxable "income." The higher the marginal tax rate, the less can the individual retain from his taxable income. This can result in a reduction in the supply of labor on the market, permitting those who work to obtain higher wages. The tax is thus ultimately shifted to people in their capacities as consumers of goods and services, and recipients of dividends, earnings, rents, and interest.

This argument, however, assumes that demand for labor does not fall off to offset the supply decline. Persons whose money incomes decline as a result of working less, or of not working more, probably also spend less. The net result may be little or no tax shifting, which is especially true during periods of price stability with relatively high levels of unemployment.

In an inflationary situation, however, demand may be great enough to push up wages.

Another consideration in supply or demand change is that progressive rates of most personal income tax laws impinge especially on the more desirable labor activities, i.e., those which generally receive the highest wages and salaries. The supply of such labor may therefore be relatively more affected than the supply of less skilled labor. However, at least one systematic study of business executives disclosed little effect of taxes on executive effort.[4] Top executives are probably more concerned with their promotion expectancies and relative standing in the company than with the extent to which the tax impinges on marginal income. Moreover, the amount of the tax which could be avoided through migration is likely to be small, partly because the deductibility of the tax from the federal income tax liability limits the progressivity of state personal income taxes. Regarding income tax deductibility, Harold Groves observes that "federal deductibility is a major defense against taxpayer migration to escape wide state tax rate differentials. It not only reduces differentials; it is a graduated privilege, much more valuable in the high brackets than in the low ones."[5] Groves finds that under the Wisconsin personal income tax law of 1956, which allows its own income tax as a deductible item against its own individual income tax base, the effect of eliminating federal tax deductibility would be to increase the state tax rate 1.50 per cent in the $2,000-$2,999 net taxable income bracket, but 5.75 per cent in the $10,000-$14,999 bracket.

A long-run consideration which might lead to some shifting of the burden of the personal income tax is that the tax will reduce the supply and therefore raise the price of capital. This is especially probable if the tax has been in effect for an extended period of time, i.e., if we have an average as opposed to a marginal tax. By reducing the net return and the source of supply of business earnings for reinvestment, the personal income tax will reduce the supply of capital and tend to raise its price, shifting a portion of the tax to users through higher prices. To the extent that state governments do not permit investors to offset capital losses against capital gains, or allow only partial offsetting, risk-taking will tend to become less attractive. In the long-run a shift from more speculative to less risky ventures also tends to increase consumer prices. Thus, the personal income tax falls partly on interest, dividends, rent, and other earnings, and partly on consumers.

In the long-run, then, it would appear that some shifting of personal income taxes does take place. However, even here, the amount of the tax shifted is probably small because of the wide variety of factors involved, some which facilitate and others which hinder shifting. We assume, therefore, that "the burden of a net income tax is relatively certain and measurable, and generally rests upon the person intended to bear it."[6]

The Personal Income Tax Theoretical Spillover Model

The theoretical spillover model of state personal income tax revenue used to finance public education is summarized in Fig. 6. This model is general in the sense that it is capable of determining both the spatial incidence of the burden of personal income tax revenue and the spatial incidence of expenditure that results from apportionment of this revenue among the school districts of the taxing state. The model, then, is capable of determining any designated jurisdiction's net spillover of state levied personal income taxes for the financing of public education.

Part ii of Fig. 6 represents the portion of the general model which determines the final spatial tax burden incidence of personal income tax revenue used for financing public education. It is based on the explicit assumption that individuals are unable to shift any portion of the burden of this tax, except by offset against their federal income tax, thus reducing their total tax liability. In this respect it is similar to portions of the general property tax model, those property taxes with both impact and incidence on the owner.

The model is appropriate for determining the spatial incidence of both an incremental personal income tax levy (short-run incidence) and an average or existing tax levy (long-run incidence). The only difference in analysis of these two situations, under the assumption of no tax shifting, is in computation of the federal income tax offset.

The first part of Fig. 6 represents the portion of the general model which specifies the expenditure or apportionment basis of the tax revenue and determines its ultimate spatial distribution. It is applicable to all other taxes levied by the state for financing public education: state sales, excise, and corporation income taxes.

Major Elements of the Personal Income Tax Spillover Model

The major elements of the personal income tax spillover model are presented in Table 18. This table is also a guide to Figs. 6 and 7. The tax incidence elements of the spillover model may be discussed in terms of two major groupings, tax impact and spatial tax incidence. The expenditure incidence is discussed in terms of a single expenditure incidence grouping.

The general procedure of analyzing both the geographical tax and expenditure incidence is to determine the amount of revenue collected by states

Table 18

Major Elements of the Personal Income Tax Spillover Model

	Line		The following symbols appear in Figs. 4 and 5.
	I-1	Revenue Category	
A.	2-6	Tax Impact	
	2	Size of Jurisdictions Category (population)	1: School District 2: Rest of County 3: Adjacent Core City 4: Rest of SMSA 5: Rest of State 6: Rest of United States
	3	Family Status	R: Related Individuals Un: Unrelated Individuals
	4	Income Class	1-13: Thirteen Adjusted Gross Income Classes
	5	Taxable Income	
	6	Tax Payment	
B.	7-8	Spatial Tax Incidence	
	7	Functional Category (Tax Offset)	TP: Taxpayer O: Offset
	8	Final Spatial Tax Incidence or Cost Spillin	Same as line 2
C.	II-V	Expenditure Incidence (Cost Spillout)	
	II	Purpose of Distribution	
	III	Method of Distribution	
	IV	Program and Basis of Distribution	
	V	Final Spatial Expenditure Incidence or Cost Spillout	Same as Line 2

Fig. 6

The Personal Income Tax Theoretical Spillover Model

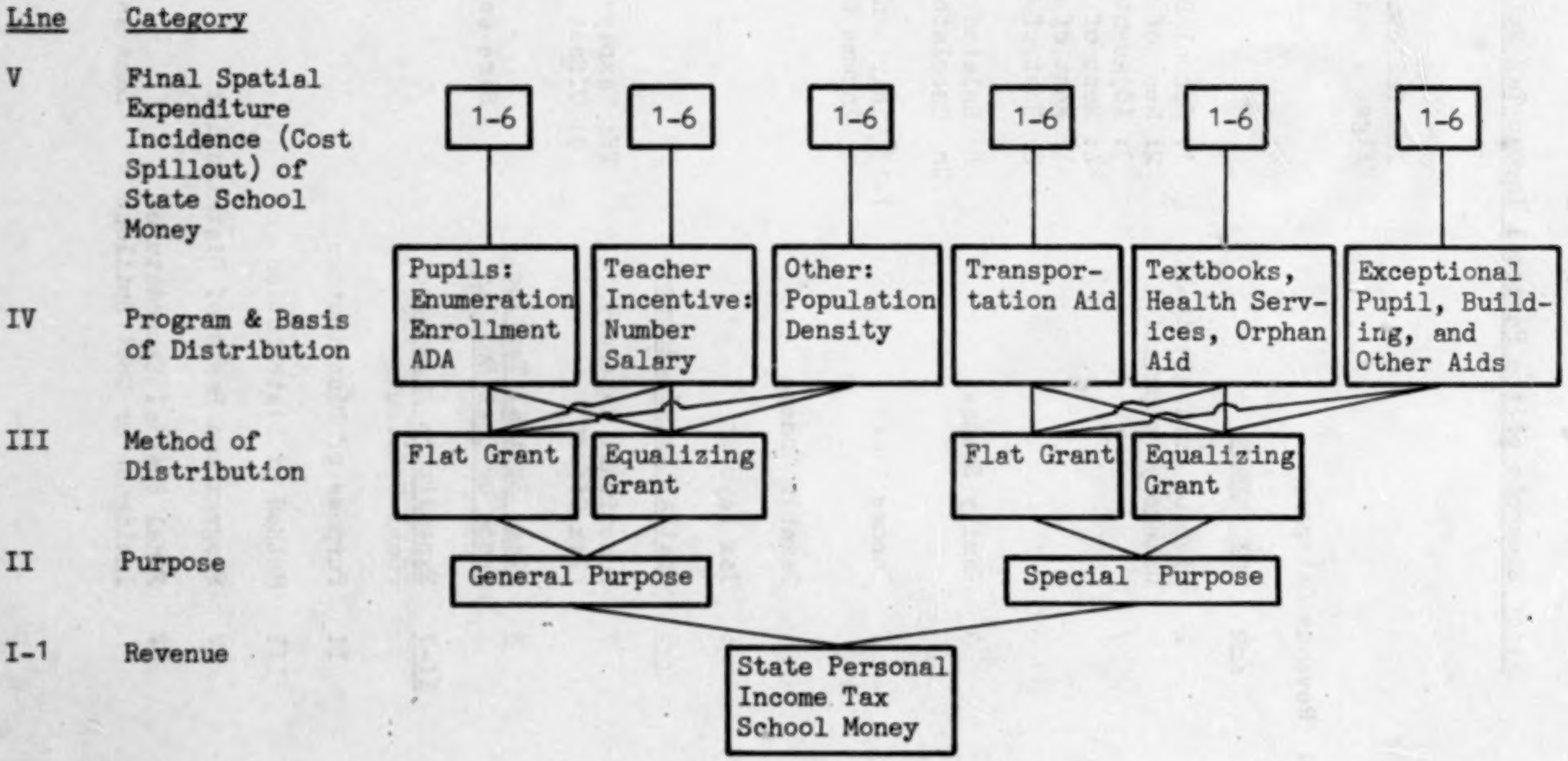
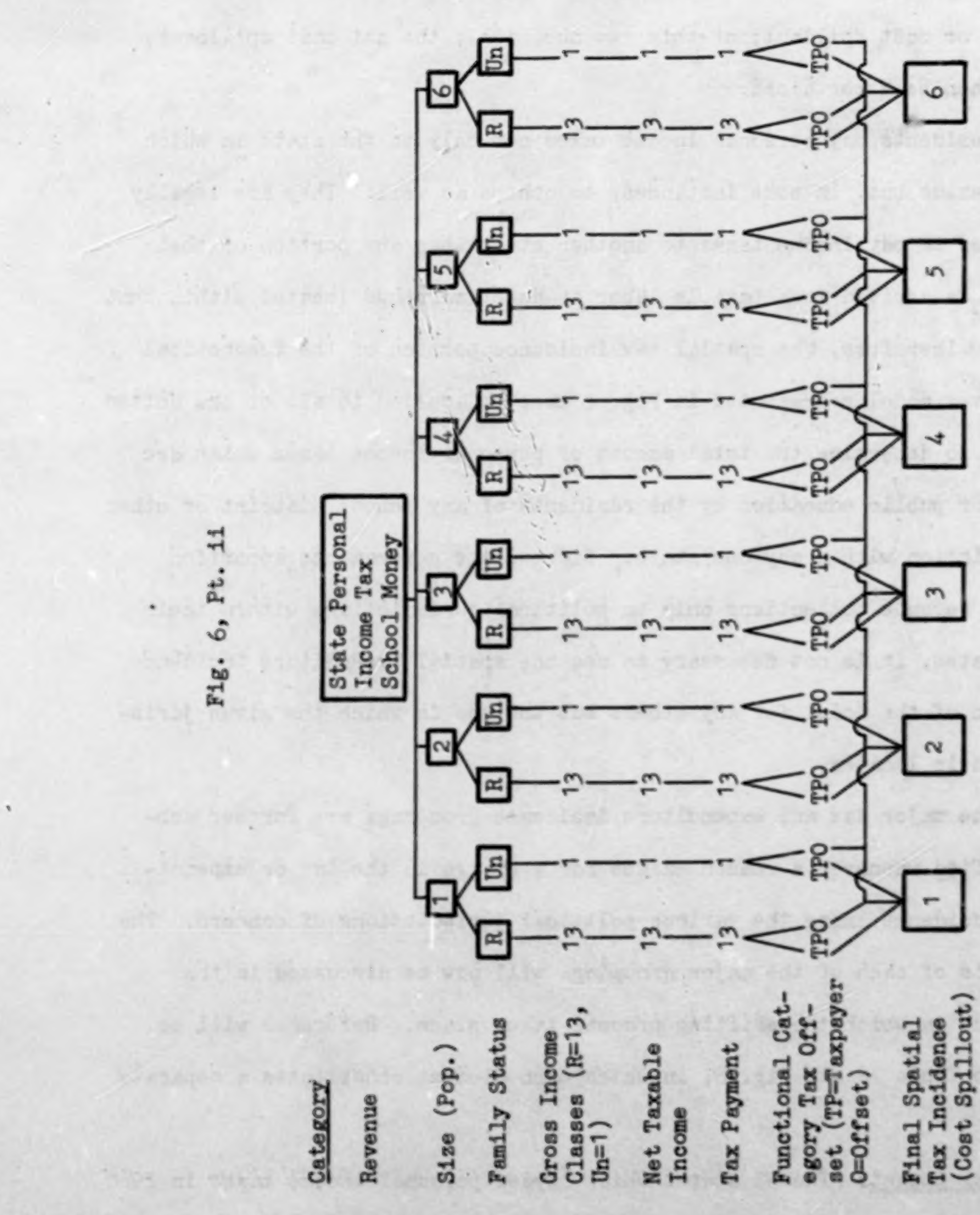

Line
Category
V
Final Spatial Expenditure Incidence (Cost Spillout) of State School Money
IV
Program & Basis of Distribution
III
Method of Distribution
II
Purpose
I-1
Revenue
1-6
1-6
1-6
1-6
1-6
1-6
Pupils: Enumeration Enrollment ADA
Teacher Incentive: Number Salary
Other: Population Density
Transportation Aid
Textbooks, Health Services, Orphan Aid
Exceptional Pupil, Building, and Other Aids
Flat Grant
Equalizing Grant
Flat Grant
Equalizing Grant
General Purpose
Special Purpose
State Personal Income Tax School Money

Fig. 6, Pt. II


Line
Category
I-1
Revenue
2
Size (Pop.)
3
Family Status
4
Gross Income Classes (R=13, Un=1)
5
Net Taxable Income
6
Tax Payment
7
Functional Category Tax Offset (TP=Taxpayer O=Offset)
8
Final Spatial Tax Incidence (Cost Spillout)
State Personal Income Tax School Money
1
2
3
4
5
6
R
Un
13
1
TPO

from personal income taxes for the purpose of public education. The final geographic tax incidence, or cost spillin, and expenditure incidence, or cost spillout, of this revenue, i.e., the net cost spillover, must then be ascertained.

Residents pay personal income taxes not only to the state in which they reside but, in some instances, to others as well. They are legally required to pay income taxes to another state when any portion of their income is derived from taxable labor or asset earnings located within that state. Therefore, the spatial tax incidence portion of the theoretical spillover model represented in Fig. 6 must be applied to all of the United States to determine the total amount of personal income taxes which are paid for public education by the residents of any school district or other jurisdiction within any one state. Since state governments apportion school revenue collections only to political jurisdictions within their own states, it is not necessary to use the spatial expenditure incidence portion of the model for any others but the one in which the given jurisdiction is located.

The major tax and expenditure incidence groupings are further subclassified whenever a reason exists for a change in the tax or expenditure incidence among the various political jurisdictions of concern. The elements of each of the major groupings will now be discussed in the sequence in which the shifting process takes place. Reference will be made to Table 18 and Fig. 6, in which each element constitutes a separate line.

Tax impact. The 33 states which levied personal income taxes in 1960 either earmarked part of the revenue for public education subsidy payments or included it in general revenue which was then used to finance such payments to the local school districts.

The first element of the impact category (line 2) is the size of the political jurisdictions in terms of the number of families and unrelated individuals. The total amount of personal income taxes paid by any jurisdiction is partly dependent on the number of its resident individuals, especially those employed.

The second element of the impact category (line 3) is the family status of individuals residing in each of the designated jurisdictions. Whether the individuals are living together as a family unit or are unrelated individuals will determine, to a certain extent, the amount of gross and taxable income realized within the jurisdiction. Usually the head of the family is the main income source for the entire family, while each unrelated individual has wage and/or other sources of income.

The third element of the impact category (line 4) is the gross income class for related family units and the mean or median gross income of unrelated individuals. Because of the wide variation in gross family income among the family units of a jurisdiction and the progressive rate of most state personal income tax laws, a jurisdiction's total personal income tax payment is determined, to a large extent, by the distribution of families according to gross income classes. Because income distribution of unrelated individuals tends to be much less dispersed, the identification of unrelated individuals according to gross income classes is not as important.

The fourth element of the impact category (line 5) is net taxable income. As a result of differences, for example, in the number of exemptions (family size) and deductions, or as a result of tax evasion, personal income tax liability and actual tax payments will vary among families in the same income class, as does the average tax liability for families in different gross income classes. This impact category may be deleted when the family units in the gross income classes are relatively homogeneous with respect to factors determining net taxable family income.

The fifth element of the impact category is the actual tax payments made by families and unrelated individuals of the jurisdiction to the state collection agency. When states use high speed electronic computers or punch card tabulating equipment, this information may be directly available. By applying the legal tax rate to the net income tax base, an estimate may be made of personal income tax payments of families by net taxable income classes, and of unrelated individuals by average net taxable income. If valid assumptions are utilized to determine a jurisdiction's net taxable income by family income classes and unrelated individuals, its estimates should equal the actual tax payments.

Spatial tax incidence. As a result of the assumption that individuals are unable to shift the burden of personal income taxes to others through market transactions, it is apparent that they can only shift the burden by offsetting these taxes against their federal personal income tax liability (line 7). Taxes paid to state and local governments may be deducted from gross income in determining federal tax liability, and thus are shifted to all taxpayers of the United States. To a small extent, part of the state personal income tax burden shifted to taxpayers of the rest of the United States will be fed back into the state levying the tax as a result of the increase by the federal government in the general federal personal income tax level, which is effected in order to maintain a constant total revenue. The amount of personal income tax burden so shifted is dependent on the net taxable income level of the taxpayer for state and federal income tax purposes, the rate of progression of state and federal income taxes, and whether an average or incremental state personal income tax levy is assumed.

A jurisdiction's final spatial tax incidence or burden of a state's personal income tax revenue collection for public education subsidy (line 8) is the sum of tax payments by the related and unrelated individuals of the total jurisdictions, minus that part of the burden shifted to the rest of the United States through the federal personal income tax offset, plus that portion of the tax offset which is fed back to local jurisdictions as a result of higher federal taxes required to maintain a constant tax revenue.

Expenditure incidence. The first element of expenditure incidence (line II) is purpose of distribution. State governments have different purposes for distributing public education funds to local school districts. Two major purposes, general and special, can be identified. General purpose distributions may be used to support any part of a local district's education program, whereas special purpose distributions identify and support a specific portion or feature.

The second element of expenditure incidence is the method of revenue distribution (line III). If no estimate of financial ability is used in calculating the distribution to school districts, it may be termed a "flat grant." Distributions which are based upon financial ability are classified as "equalizing grants."

The third element of expenditure incidence is the expenditure program and basis of distribution (line IV). State governments pursue a variety of objectives and attempt their implementation by apportioning school tax revenue through different programs with different revenue distributions.

General purpose distributions of either flat or equalizing grants are given on the basis of either pupil or classroom units. While both flat and equalizing grants use the same units as a basis of distribution, the weighting of these units is different. The objective of flat grants is to assist local initiative in providing desired educational services, while that of equalizing grants is to raise the level of support of the financially weaker districts. Equalizing grants, in addition, may require a minimum local tax contribution, or supplement local funds to attain a minimum program level. Special purpose flat and equalizing grants may be directed toward such objectives as state aid for transportation, orphans, exceptional pupils, building construction or abandonment, textbooks, health service, cafeterias, etc. The laws and statutes of the state provide for the eligibility of school districts for state school moneys. The relative importance of any one program, and the method for determining eligibility, vary widely from state to state.

The fourth and last element (line V) is the final spatial expenditure incidence. The actual apportionment to districts of public school funds is summarized in the annual public school reports for the various states. The revenue apportioned to various school districts under a state's general and special purpose apportionment programs, however, is rarely identified according to tax or revenue source. In order to identify that portion financed by a specific tax, in this instance the personal income tax, it may be assumed that it is represented in the revenue distribution in the proportion of state personal income tax revenue to total state tax revenue collection. Furthermore, it is desirable to ignore earmarking of tax sources altogether since, in the long run, they are often reassigned from one earmarked use to another.

To derive a jurisdiction's net cost spillover, its final spatial tax incidence (line 8), or cost spillins, must be compared with the jurisdiction's final spatial expenditure incidence (line V), or cost spillout. The burden of each area's cost spillout, or expenditure incidence, may be assumed to be borne by other areas according to the proportion of total state tax burden of each area, or its cost spillin.

The personal income tax spillover model can be looked upon as a simple simulation model. The effect on the output of the model—final spatial incidence—of changing the coefficients of any of the elements (lines) of either its spatial tax or expenditure incidence can readily be assessed.

Implementation of the Personal Income Tax Spillover Model for Missouri and the Rest of the United States

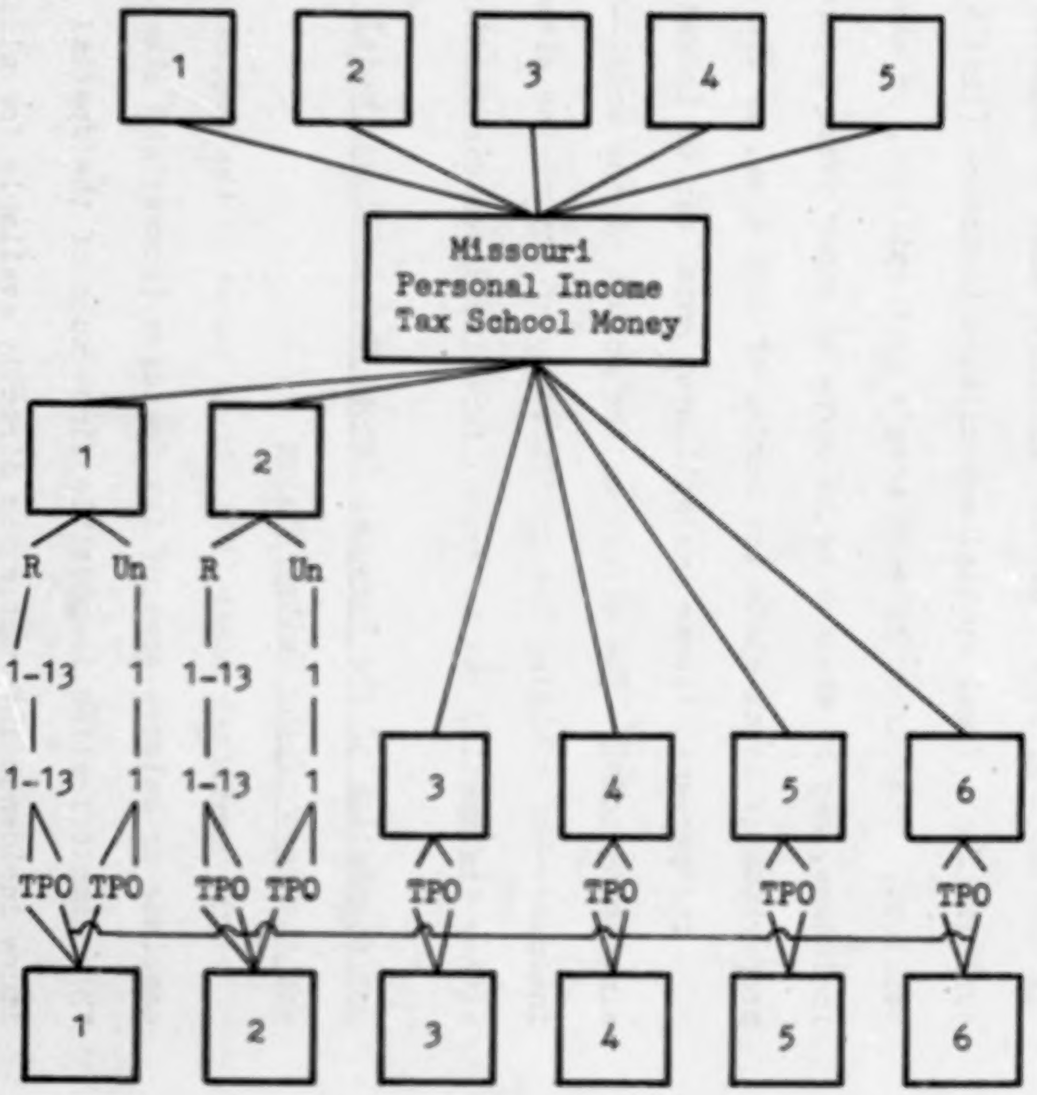
The empirical model (Fig. 7) is based on the general model but combines or deletes some of its features (boxes) and elements (lines). This simplification is possible since much of the spatial tax and expenditure incidence information is directly available for all but one political jurisdiction of interest, and because of the relatively homogeneous family characteristics of Clayton, Missouri, the jurisdiction for which the theoretical model will be implemented.

The state of Missouri originally adopted an individual income tax in 1917. It collected a total of $37,659,000 in individual income taxes and $10 million in corporate income taxes in 1960.[7] Income tax revenue, together with most other major state tax revenue sources, excluding motor vehicle taxes, becomes part of state general revenue. State of Missouri school money subsidies to counties and local school districts are financed for the most part from state general revenue. State taxes earmarked for

Fig. 7

The Personal Income Tax Empirical Spillover Model for Missouri

Line	Category
V	Final Spatial Apportionment of State School Money (Cost Spillout)
I-1	Revenue
2	Size of Major Jurisdictions
3	Family Status
4	Income Level
6	Tax Payment
7	Functional Category (TP=Taxpayer, O=Offset)
8	Final Spatial Tax Incidence (Cost Spillin)



grants to schools, the only other major school revenue source, accounted for less than 18 per cent of state school subsidy money in 1957-1958.[8] In school year 1959-1960, the state of Missouri apportioned a total of $84,334,000 to school districts of the state.[9] Personal and corporate income taxes comprised 17.8 and 4.7 per cent, respectively, of Missouri State major tax revenue in 1960, and 19.1 and 10.2 per cent, respectively, in the same year for states in the nation as a whole.

Since the state of Missouri is able to identify all personal income tax payments by individual taxpayer's county of residence, implementation of the general model is only necessary for the municipality of Clayton (jurisdiction 1), the only political jurisdiction of the empirical model smaller than a county. However, as a check on the methodology used to estimate personal income tax payments made by Clayton residents to the state of Missouri, it was also applied to St. Louis County residents. Since Clayton is a part of St. Louis County, estimated payments by Clayton residents must be subtracted from total actual St. Louis County payments to derive personal income tax payments from the rest of St. Louis County (jurisdiction 2).

In the following pages an attempt is made to indicate the data used to implement the empirical spillover model for Missouri, and produce estimates which fit into the model. These steps will be taken separately in relation to the spatial tax and expenditure incidence portions of the model.

Spatial Tax Incidence Estimation

Size of jurisdiction category (line 2). The U.S. Bureau of the Census reports that the total population of Clayton, Missouri, as of April 1, 1960, was 15,245 and of St. Louis County, 703,532.[10]

Family status category (line 3). The U.S. Census of Population for 1960 also reports the number of families and unrelated individuals by state, county, SMSA, and all urban places with a population of over 2,500.[11] The following information relates to Clayton and to St. Louis County, Missouri:

	Number of Families	Number of Unrelated Individuals
Clayton, Missouri	4,125	2,612
St. Louis County	182,626	29,153

Gross income classes (line 4). The U.S. Bureau of the Census reports the number of families resident in the above jurisdictions and groups them into thirteen different income classes; the median income of unrelated individuals for each jurisdiction is also available.[12] The following information is given for Clayton and St. Louis County, Missouri:

Number of Families by Income Class	Clayton	St. Louis County
Under $1,000	90	3,246
$1,000 to $1,999	83	4,412
2,000 to 2,999	114	5,415
3,000 to 3,999	125	7,411
4,000 to 4,999	213	13,191
5,000 to 5,999	282	22,254
6,000 to 6,999	269	23,862
7,000 to 7,999	189	21,868
8,000 to 8,999	304	18,384
9,000 to 9,999	236	13,819
10,000 to 14,999	851	31,014

$15,000 to $24,999	690	11,734
25,000 and over	679	6,016
TOTAL	4,125	182,626
Unrelated Individuals		
Number	2,612	29,153
Median Income	$1,854	$ 1,792

The first twelve of the above family income classes have a well-defined upper and lower limit. We assume that the median approximates the mean income of families in each of the income classes. The overall effect of this assumption is to underestimate a jurisdiction's total tax contribution because of the general skewness of income distribution—for lower income classes, mean is less than median family income, while for higher classes, the mean is greater than the median. Although the assumption results in overestimating income in lower income classes, this bias is more than offset by the relatively high minimum level of taxable income and the progressive rate of most state personal income tax laws. The thirteenth family income class ($25,000 and over), however, represents an open-end class. Because of the relatively large proportion of total community income (and especially of total taxable community income) in this class, and the progressive nature of state personal income tax rates, it is necessary to make a reliable and accurate estimate of mean family income for the $25,000-and-over income class.

The procedure used for this estimate in Clayton and St. Louis County is as follows:

(1) Compute total personal income within a jurisdiction by multiplying

the mean income by the number of income earners.[13]

	Clayton	St. Louis County
Mean Income (all types of income)	$8,391	$5,405
Number of Recipients	x 9,590	x 333,366
Total Community Income	$80,469,690	$1,801,843,230

(2) Subtract from total community income the total income of families with less than $25,000 annual income and the total income of unrelated individuals. Assume that mean and median income is the same by family income class and by unrelated individuals of a community.

	Clayton	St. Louis County
Total Community Income	$80,469,690	$1,801,843,230
Minus Total Income of Families with Less than $25,000 Income	35,853,500	1,459,297,500
	$44,616,190	$ 342,545,730
Minus Total Income of Unrelated Individuals	4,842,648	52,242,176
Total Income of Families with More than $25,000 Income	$39,773,542	$ 290,303,554

(3) The residual income may be imputed to the open-end family income class, which, divided by the number of family units, results in an estimate of its mean family income.

	Clayton	St. Louis County
Total Income of Families with More than $25,000 Income	$39,773,542	$290,303,554

Number of Families with More than $25,000 Income	679	6,016
Estimated Mean Income of Families with More than $25,000 Annual Income	$58,577	$48,255

Net taxable income (line 5). Because of the relatively homogeneous socio-economic family characteristics of the municipality of Clayton, it was assumed that every family within the same income class had identical net taxable personal income. Thus, it was implicitly assumed that in a given income class, all families with identical incomes pay identical federal income taxes, have identical numbers of exemptions and identical values of itemized deductions, and evade state personal income taxes to the same extent.

Tax payment (line 6). The state personal income tax liability of families in the various income classes is determined by net taxable income, not by gross. Table 19 illustrates the determination of Missouri taxable personal income, together with estimated Missouri personal income tax payments of Clayton, Missouri. As a check on the accuracy of the procedure, the same method was used to estimate Missouri personal income tax payments of St. Louis County residents, for which actual tax payment records are available.

The total gross personal income of families by income class, and of unrelated individuals (column 3), was estimated by multiplying the number of families by mean family income of each income class (assuming mean and median class income to be equal), and the number of unrelated individuals by their median income.

Federal personal income tax payments are deductible from gross income

Table 19

Missouri State Personal Income Tax Collection Estimates for Clayton, Missouri - 1960

1. No. of Families	2. Mean Family Income	3. Total Income	4. Federal Income Tax Offset (St. Louis SMSA Effective Rate)
90	$ 750	$ 67,500	$ 763
83	1,500	124,500	6,960
114	2,500	285,000	21,062
125	3,500	437,500	38,850
213	4,500	958,500	94,892
282	5,500	1,551,000	154,945
269	6,500	1,748,500	182,893
189	7,500	1,417,500	168,824
304	8,500	2,584,000	316,540
236	9,500	2,242,000	305,585
851	12,500	10,637,500	1,561,585
690	20,000	13,800,000	2,558,520
679	58,577	39,773,542	10,512,147
Unrelated Individuals 2,612	1,854	4,842,648	270,704
		$80,469,690	

Table 19 Part ii

5. Exemption (Average Family Size 3.06=$2,824)	Deductions 6. Itemized (Same % as on Federal and same Effective Rate)	 7. Flat Deduction (5% $10,000 10% $10,000)	8. Evasion (10% of Gross Income)
$ 254,160	$ 1,180	$ 3,266	$ 6,750
234,392	6,697	5,338	12,450
321,936	20,129	10,726	28,500
353,000	35,862	14,613	43,750
601,512	86,686	28,233	95,850
796,368	164,753	37,658	155,100
759,656	194,420	38,205	174,850
533,736	156,411	29,562	141,750
858,496	280,679	53,218	258,400
666,464	245,340	44,772	224,200
2,403,224	1,174,908	209,186	1,063,750
1,948,560	1,662,006	154,560	1,380,000
1,917,496	4,979,259	217,959	3,977,354
Unrelated Individuals 3,134,400	260,504	207,629	484,265

Table 19 Part iii

9. Missouri Taxable Income	10. Missouri Taxable Income by Family	11. Missouri Tax by Family	12. Estimated Total Missouri Personal Income Tax
-	-	-	-
-	-	-	-
-	-	-	-
-	-	-	-
$ 51,327	$ 241	$ 2.41	$ 513
242,176	859	8.59	2,422
398,476	1,481	17.22	4,632
387,217	2,049	25.98	4,910
816,667	2,686	38.72	11,771
755,639	3,202	50.05	11,812
4,224,847	4,965	94.13	80,105
6,096,354	8,353	202.36	139,628
18,169,327	26,759	935.36	635,109
			890,902
485,146	186	1.86	4,858
			895,760

in computing Missouri taxable income. Federal personal income taxes paid by Clayton and St. Louis County residents, according to adjusted gross income class, were estimated by applying the effective federal personal income tax rate, by adjusted gross income classes in the St. Louis SMSA for 1959, to the Clayton and St. Louis County adjusted gross income classes (see Tables 19 and 20).

In computing 1960 taxable income, the state of Missouri allowed an exemption of $1,200 for unrelated individuals, $2,400 for married couples, and $400 for each dependent. The average 1960 family size in Clayton was 3.06 persons and in St. Louis County, 3.69 persons.[14] It was implicitly assumed that this average family size remained constant throughout the family income range. A flat exemption of $2,824 per family was therefore used for Clayton and $3,080 per family, for St. Louis County.

The state of Missouri allows miscellaneous deductions in computing net taxable personal income. As for federal tax purposes, the taxpayer may either take a standard deduction or itemize his deductions. In general, the state of Missouri follows the pattern of the federal government in the amount of allowable miscellaneous deductions. However, Missouri permits a maximum of only 15 per cent of gross income to be deducted in the form of contributions to religious and non-profit institutions, as compared to a maximum of 20 per cent for federal income tax purposes; on the other hand, the state of Missouri allows federal social security taxes to be deducted, while the federal government does not.

Because of the close similarity between the federal and Missouri personal income tax laws with regard to miscellaneous deductions, the per cent of all United States taxpayers by income class who itemized deductions on federal personal income tax returns for 1960 was assumed to hold for

Table 20

Federal Personal Income Tax Rate, Per Cent of Taxpayers Who Itemize Deductions, and Itemized Deductions as a Per Cent of Adjusted Gross Income Classes

Adjusted Gross Income Classes	Effective Federal Income Tax Rate (Taxes as a per cent of gross income) in the St. Louis SMSA for 1959	Per Cent of Taxpayers who Itemize Deductions in the U.S. for 1960	Total Itemized Deductions as a Per Cent of Adjusted Gross Income for the U.S.
Less than $1,000	1.13	3.22	54.29
$1,000 to $1,999	5.59	14.25	37.75
2,000 to 2,999	7.39	24.73	28.56
3,000 to 3,999	8.88	33.20	24.69
4,000 to 4,999	9.90	41.09	22.01
5,000 to 5,999	9.99	51.44	20.65
6,000 to 6,999	10.46	56.30	19.75
7,000 to 7,999	11.91	58.29	18.93
8,000 to 8,999	12.25	58.81	18.47
9,000 to 9,999	13.63	60.06	18.22
10,000 to 14,999	14.68	63.77	17.32
15,000 to 24,999	18.54	77.60	15.52
25,000 to 49,999	26.43	89.04	14.06

Source: U.S. Treasury Department, Internal Revenue Service, Statistics of Income, Individual Income Tax Returns for 1959, U.S. G.P.O., Washington, 1961, Table 18.

Clayton and St. Louis County taxpayers in determining Missouri personal income tax liability. Itemized deductions, as a per cent of adjusted gross income, were assumed the same for both federal and Missouri State income tax liability. However, since the Missouri personal income tax law allows only 5 per cent of unadjusted gross income to be deducted by persons with incomes under $10,000 who do not itemize, only 5 per cent was assumed deducted from gross income by these individuals in determining taxable income; however, a flat 10 per cent was applied to incomes over $10,000 on the assumption that since these individuals were able to take a 10 per cent miscellaneous deduction on their federal personal income tax returns, they would probably itemize deductions for Missouri personal income tax purposes, rather than take less.

As a result of tax evasion, a certain amount of gross income of a state does not become part of state taxable income. The proportion of state gross personal income which is evaded is dependant upon such factors as tax enforcement, tax loopholes, and taxpayer morale. A personal income tax withholding collection system went into effect in Missouri on July 1, 1961, and produced about $7 million in additional revenue in the first year—an increase of 13 per cent over the previous fiscal year.[15] With personal income in the state of Missouri increasing less than 4 per cent per annum in the period April, 1961 to April, 1962,[16] it would appear that at a minimum, 10 per cent of Missouri State taxable income is evaded. It was assumed that this 10 per cent evasion rate applied equally throughout the income range for Clayton and St. Louis County.

Missouri taxable income was estimated by subtracting the above four items, i.e., federal income taxes, exemptions, deductions, and evasions, from gross income by family income class. The Missouri personal income tax payment per family by income class was derived by applying the appropriate tax rate to net taxable income less an estimated authorized tax credit. Total estimated Missouri personal income tax payments for Clayton and St. Louis County were derived by multiplying the estimated average tax payment of a family in the two areas by the number of families in each income class. A total of $895,760 was estimated to have been paid by Clayton residents in Missouri personal income taxes in 1960. By using the identical procedure, a total of $11,771,529 in Missouri personal income taxes was estimated to have been paid by St. Louis County residents in 1960; this amount was 6.4 per cent below actual total Missouri personal income tax payments of $12,577,693. The estimate for Clayton, therefore, is probably also a low estimate of actual payment.

Functional category (tax offset) (line 7). The portion of each jurisdiction's Missouri personal income tax payment estimates for state public education subsidies, which may be offset against federal personal income tax liability, was computed for both a marginal and an average state personal income tax. The average state personal income tax offset rate was based on the effective federal income tax rate (taxes as a per cent of gross income) in the United States for 1960, and was applied to the mean income of all income recipients for each jurisdiction; the marginal state personal income tax offset rate was based on marginal federal income tax rates applied to gross mean income of income recipients by jurisdiction, minus two exemptions per income recipient and deductions comparable to the national average for the respective gross income classes. The final burden of these offset taxes was assumed borne by all areas in proportion to each area's estimated total federal personal income tax payments to total national personal income tax collection in 1960.

Final spatial incidence (line 8). The final spatial incidence of the Missouri personal income tax for public school subsidies is summarized in Table 21.

Spatial Expenditure Incidence Estimation

Purpose of distribution (line II). The state of Missouri distributes all state school moneys under the provisions of its Foundation Program. State aid is thereby allocated to both general and special aid; the latter has been incorporated into the Foundation Program and has become part of the state school apportionment in the same manner as basic aid.[17] The state constitution provides that not less than one-fourth of the general fund revenue is to be appropriated for schools: traditionally the legislature has appropriated one-third or more of the general fund revenue for this support. Beside legislative appropriations, which in 1957-1958 accounted for 81.9 per cent of state school aid funds, there are earmarked state taxes and permanent school endowments which in the same period accounted for 17.9 and .2 per cent, respectively, of state school aid funds.[18] As noted previously, all earmarking of state funds for public education was ignored; the proportion that state personal and corporate income tax collections comprised of total major state tax revenue sources was assumed to be the portion of state financed direct public education cost, financed by personal income taxes (Table 2).

Method of distribution and program (lines III and IV). The general aid distribution of the state of Missouri involves three programs: the equalization quota, the teacher preparation allowance, and an additional amount frequently referred to as the flat grant. The special aid consists of four programs: aid for orphans, for handicapped children, building

Table 21

Final Spatial Incidence of Missouri Personal Income Taxes By Area (in percentages)

Area	Average Tax	Marginal Tax
1	2.090	1.767
2	28.089	24.320
3	15.418	13.370
4	2.077	1.858
5	37.514	32.544
6	14.812	26.141

Clayton's Burden of the Rest of the United States State Personal Income Taxes (in percentages)

Area	Average Tax	Marginal Tax
1	0.002	0.002
6	99.998	99.998

abandonment, and for transportation. The state of Missouri also makes payments to school districts for vocational programs, and requires county clerks to apportion the foreign insurance tax money to the "free textbook fund" for all school districts of the state. Table 22 summarizes the programs of the state of Missouri for 1959-1960. Basic aid programs account for approximately 80 per cent of total state apportionment, and the balance is derived from special and other programs.

The equalization quota of the basic apportionment is determined by the number of resident students in average daily attendance (ADA) multiplied by $130 less deductible funds, i.e., all revenue obtained from $1.00 local tax rate per $100 assessed valuation, and the amounts received from county and township school funds, from state assessed utilities, and from intangible taxes.

The teacher incentive apportionment is determined by teacher preparation: $405 for each teacher with 150 or more college hours, and $270 for each with 120 to 149 college hours.

A school district's flat grant is determined by adding the number of resident pupils in ADA and the number of non-resident pupils whose tuition the district of residence is required to pay. The total thus obtained is multiplied by $102.

To participate in state transportation aid, a district must transport resident and non-resident high school pupils, and resident elementary pupils, one mile or more, over approved routes, under statutory provision for authority transportation. State transportation aid is based on an allowance per pupil per month, determined by the number of pupils transported per mile, but not to exceed actual district cost.

To participate in Missouri exceptional pupil aid, a district must

Table 22

Apportionment of Public School Moneys of the State of Missouri for 1959-1960, by Program (in $000)

Program	Total Amount	Percent of Total
Equalization	$ 11,247.1	13.37
Teacher Incentive	7,136.3	8.48
Flat Grant	48,467.0	57.63
Transportation	7,610.3	9.05
Exceptional Pupil	2,193.8	2.61
Orphan	48.2	.06
Building (Abandonment)	33.0	.04
Total General Apportionment	$ 76,735.7	91.24
Vocational Programs	1,573.7	1.87
Free Textbook Fund	5,794.6	6.89
	$ 7,368.3	8.76
Total All Apportionment Programs	$ 84,104.1	100.00

Source: One Hundred Eleventh Report of the Public Schools of the State of Missouri. School year ending June 30, 1960 (Jefferson City, Mo., 1961), Tables 28, 29, pp. 74-75, and Table D, p. 126.

organize special classes that meet state requirements. They include those for the orthopedically handicapped, hard of hearing, partially seeing, mentally deficient, and mentally retarded pupils, and for those with speech defects. The maximum state aid is specified in the law and varies depending on the type of exceptional pupils receiving instruction.

To receive orphan aid, districts report the number of orphans or dependents from orphans' homes in attendance in the public schools. The 1957-1958 apportionment was not to exceed $2.75 per child per month, per approved orphan pupil.

An allowance of $1,000 is made for each elementary school building abandoned during the year in connection with construction of a new central school.

Vocational aid is given to districts to partially defray the cost of conducting vocational departments in high schools.

All moneys to the credit of the state's county foreign insurance tax fund are divided by total state, school-age, pupil enumeration, thus determining the amount of free textbook aid per enumerated pupil. This amount is then multiplied by the number of enumerated pupils in the district. Money from this source must be used in the district for purchase of textbooks and instructional materials.

Final spatial expenditure incidence (cost spillout) (line V). The spatial expenditure incidence, or cost spillout, of 1959-1960 Missouri school moneys is summarized in Table 23. These apportionments were used to compute the portion of each jurisdiction's direct cost which was financed from state revenue sources (Table 2). Approximately 22.5 per cent of Missouri state financed direct cost is assumed derived from state personal income taxes.

Table 23

Apportionment of Public School Moneys of the State of Missouri for 1959-1960, by Area (in $000)

Area	
1. Clayton, Missouri	$ 186.0
2. Rest of St. Louis County	9,659.4
3. St. Louis City	8,475.9
4. Rest of SMSA *	1,889.8
5. Rest of Missouri	63,893.0
Total	$ 84,104.1

* St. Charles and Jefferson Counties only

Source: One Hundred Eleventh Report of the Public Schools of the State of Missouri. School year ending June 30, 1960 (Jefferson City, Mo., 1961), Tables 28, 28, pp. 74-75, and Table D, p. 126.

Clayton's Spillin of Other State Personal Income Tax-Financed Direct Cost

Clayton residents do not incur a cost spillin from area 6, the rest of the United States, through Missouri income taxes, since all apportionments of Missouri State revenue are made only to jurisdictions within the state boundary. However, Claytonians incur a cost spillin of area 6 personal income taxes to the extent that Clayton residents realize and pay state taxes on income from out-of-state sources. Lacking specific information on the amount of state personal income tax payments by Claytonians to other states in 1960, an estimate was made based on the assumptions that (1) other states spill out the same percentage of their personal income tax costs as Missouri, i.e., $\frac{\$\,2{,}759.0}{37{,}658.7} = 7.326\%$, and that (2) Clayton's share of this 7.326% is proportionate to the number of Clayton income recipients, weighted by the percentage of Clayton recipient mean income to the national mean income, relative to the number of income recipients in the entire nation.

After applying the appropriate average and marginal offset rates, and spatially distributing the amount offset, Clayton residents were estimated to incur 0.002 per cent of the burden of the rest of the United States' state personal income taxes.

Summary: Net Cost Spillover Spatial Incidence Findings

Clayton school district's coefficients of public education personal income tax-financed direct cost spillout and spillin were multiplied by the absolute amount of each geographic area's direct cost financed by income taxes, to derive Clayton's personal income tax cost spillin and spillout by area. Clayton's spillover of the operating portion of direct costs financed by state income taxes is summarized in Table 24.

Table 24

Clayton School District Burden of Direct Operating Costs Financed by State Income Taxes, 1960

Area	Average Tax	Marginal Tax
1 (Clayton)	$ 824.	$ 697.
2-6 (Spillout)	38,621.	38,748.
Total	$ 39,445	$ 39,445
Spillout To:		
2	$ 11,080.	$ 9,593.
3	6,082.	5,274.
4	819.	733.
5	14,797.	12,837.
6	5,843.	10,311.
Total 2-6	$ 38,621.	$ 38,748.

Spillin to Clayton of Direct Operating Costs of Other Areas, Financed by State Income Taxes

Spillin from:		
2	$ 39,913.	$ 33,749.
3	35,897.	30,349.
4	0.697.	8,198.
5	326,014.	275,630.
6	31,022.	31,022.
Total 2-6	$442,548.	$378,948.
Clayton	$ 824.	$ 697.
Others	442,548.	378,948.
Total Clayton Burden	$443,372.	$379,645.

Although Clayton residents incurred an estimated aggregate burden of $443,000 and $380,000 under average and marginal tax assumptions, respectively, only about $40,000 of income tax burden resulted from the provision of public education in Clayton. While Clayton spilled out almost all of the burden resulting from personal income tax revenue used to finance its own public education, i.e., about $39,000 under both average and marginal assumptions, this cost spillout was overwhelmingly reversed by cost spillins from other areas of $443,000 and $379,000 under average and marginal assumptions, respectively. Thus, Clayton experienced a net cost spillin of about $400,000 and $340,000 of personal income tax-financed direct operating cost under average and marginal tax assumptions, respectively. Although Clyaton had a net cost spillin with each of the five areas, 77 per cent of the net cost spillin, under both an average and marginal tax, was from area 5, the rest of Missouri, while the rest of the net cost spillin came, evenly divided, from areas 2, 3 and 6.

Chapter V

STATE SALES AND EXCISE TAXES LEVIED TO FINANCE OPERATING COSTS

Introduction

Incidence of general retail sales and excise taxes is of importance in the study of the spillover of public education costs because of their significance as revenue sources of state governments in the support of public education. Thirty-four of the 50 states levied general sales and excise taxes in 1960, accounting for about 61 per cent of all state tax revenue collected, excluding motor fuel and vehicle taxes that are generally permanently earmarked for highway purposes. The addition in 1962 of Texas and Wisconsin to the list of states with sales taxes left only 14 without a tax on purchases. Personal and corporate income taxes, imposed by 33 and 37 of the states respectively, accounted for about 26 per cent of all state total non-highway tax revenue. The sum of all sales, excise, and income taxes, except for motor fuel sales and excises, accounted for almost 90 per cent of all revenue (excluding intergovernmental revenue) in 1960.[1] Except for motor fuel excise taxes, all major sources of state government general revenue are included in the tax incidence study, since in the long run, earmarked general revenue funds tend to be utilized to finance non-earmarked functions.

General and Theoretical Considerations

General Shifting Assumptions

The public education spillover study will pose the question of tax incidence in two different ways; What is the incidence of a given state's incremental levy of general retail sales and excise taxes? What is the incidence of a state's present general retail sales and excise taxes?

The first approach is based on the assumption that any additional expenditure of money by the state for the purpose of public education requires a tax increase. The second approach assumes that, at the state level of government, an increase in the amount of money devoted to public education does not necessarily require a tax increase, but only a reallocation of state general revenue. The first approach introduces a change in the tax structure, while the second attempts to determine the incidence of a tax within a given tax structure.

The most appropriate approach is dependent upon specific conditions within the various states. A state with a rising total tax revenue from its existing tax structure may readily appropriate more money for educational purposes, while another with a constant total tax revenue, together with rising expenditure on other functions, may require a tax increase to finance a larger appropriation for public education.

We have visualized a static time period analysis of cost-benefit spillover. This framework calls for a short-run partial equilibrium approach to both questions related to the analysis of tax incidence. Both the average (incidence of present taxes) and marginal (incidence of an incremental tax) methods attempt to determine the geographic incidence of a given tax revenue. Use of an average tax approach does not necessitate a long-run tax incidence model. The distinguishing feature of both methods in the determination of geographic tax incidence is the difference in treatment of the federal income tax offset rather than any difference in shifting assumptions. The difference in treatment of the federal income tax under both an average and marginal tax is subsequently discussed.

The questions of sales and excise tax incidence have been posed in relation to taxes raised by all states of the nation. Tax revenue raised through these taxes by other states, which ultimately becomes a burden on residents of the given state, are included in the general sales and excise tax model. While it can be shown that spillovers (both spillouts and spillins) between states are negligible if (1) residents of the various states are infrequent tourists or consumers in other areas, (2) business firms are not taxed on their factor inputs or these taxes are relatively negligible, (3) sales and excise taxes are shifted entirely to consumers in all of the states, and (4) state sales and excise tax revenue is not offset against federal income tax liability, these conditions are not sufficiently prevalent to ignore spillover of sales and excise taxes between states. Generally speaking, these conditions are inapplicable in many states (1) where tourism is an important industry, or in which there are large metropolitan areas adjoining state boundaries with a consequently large proportion of the state's sales to out-of-state consumers, (2) which raise a significant percentage of tax revenue from taxes levied on business purchases, (3) which are unable to shift the tax to consumers because of out-of-state competition or other conditions, and (4) because the federal government permits individuals to offset direct state government taxes when computing their federal income tax liability.

As in the other chapters concerned with cost incidence, a partial equilibrium approach is taken. This form of analysis permits us to neglect the possible effects of sales-excise taxes upon the level of state and national employment. In addition, we assume an appropriate monetary policy to realize the philosophy and objective of the incremental tax legislation, i.e., an increase in the stock of money and credit to support the general increase in consumer prices resulting from shifting the tax forward to consumers. Finally, we neglect any backward shifting of the tax as a result of government failure to make the necessary monetary expansion.

A survey of the existing literature on shifting and incidence of general retail sales and excise taxes reveals a prevailing consensus that their burden rests on the consumer. This consensus is based on abstract reasoning using economic models; moreover, empirical evidence of sales and excise tax incidence is negligible. These economic models are mainly concerned with the distribution of the burden of a national retail sales tax of universal coverage, i.e., a tax applying to final sales of all goods and services to the consumer. According the John F. Due, the burden on all sales to final consumers of such a national, uniform-rate general sales tax is distributed among individuals in proportion to expenditure on the taxed goods and services.[2] This conclusion rests upon the following assumptions: (1) retail markets are not purely competitive; (2) firms that sell at retail use average-cost pricing techniques in response to a general cost increase resulting from an increased retail sales tax of universal coverage; (3) a monetary policy is pursued, consistent with the philosophy that the tax is borne by consumers; (4) sales tax revenues are used by the government to acquire factor units or commodities; (5) a sales-consumption ratio is stated in monetary terms; (6) full employment exists; and (7) changes in the general price level do not affect factor prices.

Shifting of State Sales Taxes

The assumptions summarized in the preceding paragraph, together with the resulting incidence, do not appear to be unrealistic in terms of a general statement pertaining to a national retail sales tax of universal coverage. However, the following modifications are necessary for the state retail sales taxes with less than universal coverage.

(1) The distribution of the burden of an incremental increase in a single state's general retail sales tax may differ from that of an increase in a comprehensive federal tax. Through competition, firms located in a low tax-level state may force firms located in a high tax-level state to absorb all or part of the tax. The implications of tax level differentials may be significant in multistate urban areas. However, tax level differentials do not significantly restrict tax shifting to the consumer in the short run because:

a) tax level differentials are generally not large enough to compensate the consumer for the cost of traveling to escape higher taxes on purchases,

b) taxes levied on out-of-state purchases, and cooperative collections of sales taxes on purchases of residents in border communities, tend to eliminate the incentive to purchase out-of-state,[3]

c) for each incremental tax there is also a compensating incremental benefit which at least partially reduces the incentive of both firms and individuals to relocate.

In addition, the maintenance of price level differentials (inclusive of tax) between areas with tax level differentials suggests that sales and excise taxes are shifted to the consumer.

(2) In constructing a shifting model for the various sales and excise taxes, it will be assumed that the tax is single-stage, levied at the retail level. This assumption ignores multiple-stage taxes and sales taxes levied at other than the retail level. In accordance with the practice of most states, a retail sale is defined as including all sales except those for resale. This means that if the commodity being sold is a material ingredient in another product to be sold in the future, no tax applies; if, however, the commodity being sold only facilitates production, without becoming a physical ingredient, the tax is applicable. Taxable sales to business are thus accounted for in the model. As a general case, these assumptions are not too limiting because:

a) In 1958, 33 of the 48 states levied sales taxes. Of these, one had a gross income tax (Indiana), two a general sales tax (Mississippi and North Carolina), one a gross receipts tax (New Mexico), and two had both a retail sales and gross receipts tax (Washington and West Virginia). All of the remaining states levied retail sales taxes.

The retail sales taxes vary from state to state but in general are limited to retail sales of tangible commodities. In nine states (one additional state was preparing to vote on the measure), food was exempt. In some states the tax extends to restaurant meals, hotel rooms, etc. In only two states does the general sales tax include both retail and wholesale transactions (Mississippi and North Carolina). The gross receipts tax extends to sales of manufacturers, wholesalers, and retailers in only three states, and occasionally professional and personal services (New Mexico, Washington, and West Virginia). Indiana is the only state that employs the relatively comprehensive turnover or transaction tax. Of the 36 states that imposed sales taxes in 1961, 13 did so at rates below 3 per cent, and 23 at rates ranging from 3 to 4 per cent.[4]

b) The proportion of the sales tax paid on sales to businesses is relatively large. Musgrave and Daicoff considered this proportion in Michigan to be approximately 15 per cent; Harold Groves estimated it to be 20 per cent in Wisconsin.[5]

(3) The exemption from the tax base of some goods and services is assumed to affect the distribution of the tax burden in the following ways:

a) It affects expenditure on taxed items, rather than the proportion of income spent on consumption of final goods and services.

b) Demand schedules will tend to be more elastic than under the more general tax, with the result that the tax is not as readily shifted by firms. To the extent that the change in relative prices of the various goods and services produces factor-price changes, especially probable because of additional government expenditure, a redistribution of real income results. This is the result of inelasticity of supply of these factors.

(4) If the tax rate is low, and particularly if the change involves

departure from established price lines, some firms may not attempt to make readjustments. However, the usual change in the sales tax rate is a minimum of ½ per cent, which is large relative to the total tax rate. Most states require separation of the sales tax from the list-selling price of the taxable item. This is an additional factor which facilitates forward shifting of the tax.

Shifting of State Excise Taxes

There are two types of excise taxes: ad valorem and unit taxes. Unit taxes become more burdensome at lower unit prices. For this reason the tax may be more difficult to shift on items of a low per-unit selling price competitive with similarly taxed items of a high per-unit selling price. However, standardization of prices on these taxed commodities tends to minimize the difficulty of shifting unit taxes. For example, since most brands of cigarettes are priced at about 30¢ per package, give of take a few cents, a 1¢ per package tax results in a negligibly higher ad valorem rate on lower priced than on higher priced brands of cigarettes. The more standardized is the price of a taxed commodity, the more nearly does a unit tax, in effect, become an ad valorem tax, which minimizes the difficulty of shifting unit taxes.

There will only be a few modifications in the state sales tax model for the shifting of state excises

Since the excises apply only to specified commodities, in most cases the model will include only a retail sector. It will not be necessary to include sales to businesses, since the excises are generally levied only on household consumption goods.

Excise taxes are levied on goods which are relatively difficult to purchase out-of-state in any large quantity for in-state consumption. For example, if cigarettes are taxed at a higher rate in Missouri than in Illinois, people are unlikely to make trips to Illinois to purchase cigarettes. This factor tends to make interdistrict excise tax differentials of little consequence. It is probably true, however, that in a few multistate border areas, especially those including large urban areas, the ability to shift excise taxes may be circumscribed as differentials become large and there is an increase in the economic interaction between one tax jurisdiction and a bordering jurisdiction. Thus, for example, with little additional time and effort, a person who resides in one tax jurisdiction and works in another may purchase the taxed commodities in the jurisdiction of work rather than of residence. The incentive is the lower price quoted by firms in the lower excise tax jurisdiction. Firms in the high tax jurisdiction would then be under competitive pressure to absorb the tax differential, rather than pass it on to the consumer.

Exceptions to the above treatment occur when the tax is levied at other than the retail level and/or on out-of-state sales. In some such instances, when a differential tax exists, some burden of the tax may fall on the specialized factors of production, although it may be contended that they are not so specialized, and therefore the burden in large part falls on consumers.

One may also contend that since the excise taxes are levied on specific commodities, the ease of substitution for these taxed items is great and will result in output effects. However, the fact that excise taxes tend to be levied on state and local government levels because of the stability of revenue is a counter argument. Output effects are small since demand for the taxed item is highly inelastic. This view is expressed by

Denzel C. Cline: "The special taxation of alcoholic beverages and cigarettes has been justified or rationalized on various non-fiscal grounds, such as their 'harmful' effects or their 'luxury' characteristics. But it is the remarkable revenue-producing power of these levies which has been so attractive to revenue authorities."[6] Harold Groves confirms this view when he states, "Outside its ease of collection, the tobacco tax has appeal the world over because the demand for tobacco is highly inelastic. This permits the tax-makers to hang a fantastic tax on an otherwise cheap product and keep the consumer coming back for more."[7]

In summary, in the short-run, excise taxes are generally shifted to consumers, most of whom are essentially residents of the taxing state.

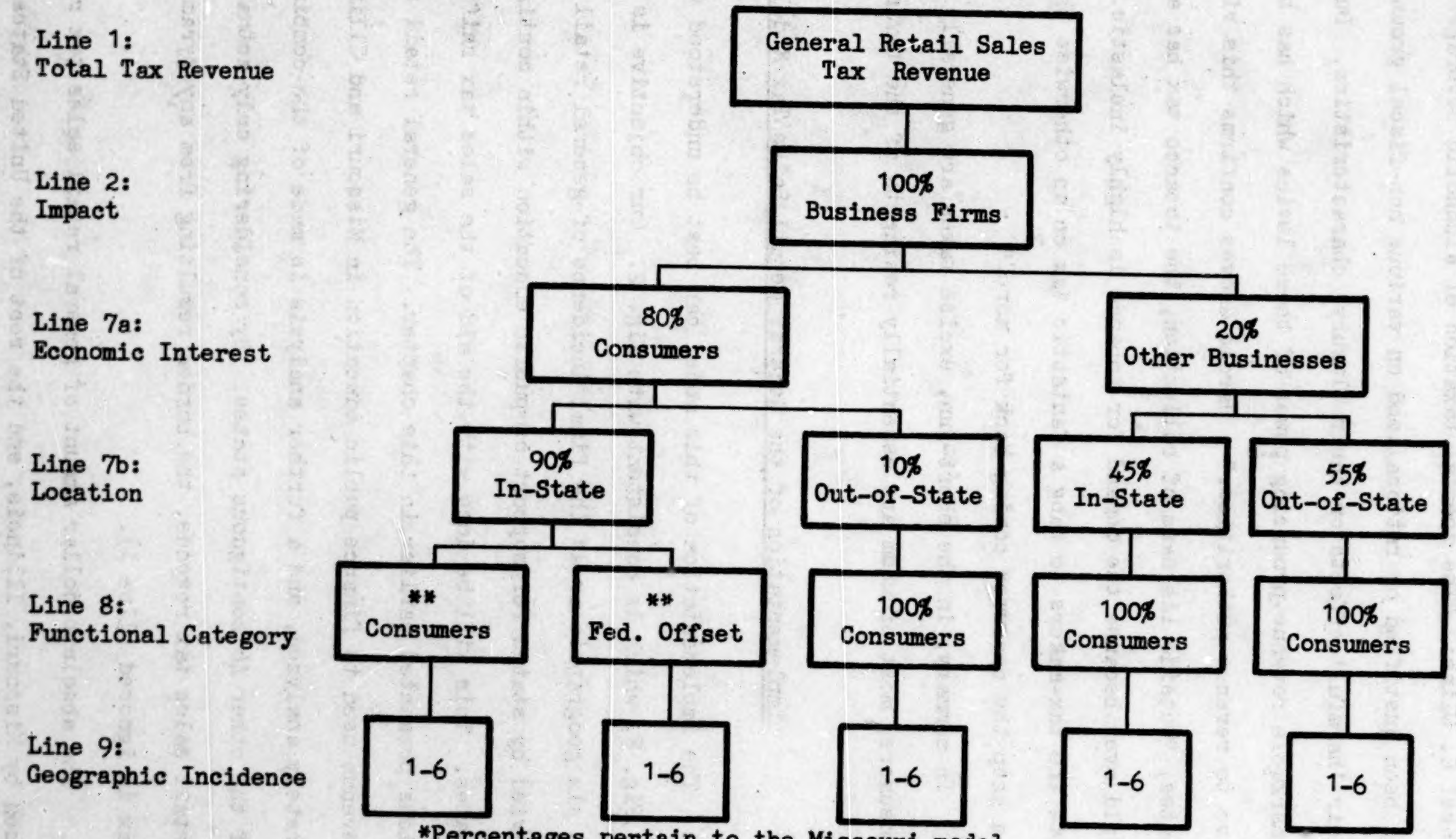
Implementation of the General Retail Sales Tax Model

The implementation of this model can best be understood with the help of Fig. 8, which is consistent with Fig. 2. Our objective is to allocate to six geographic areas the final incidence of general retail sales taxes levied by states for support of public education within contiguous United States. This will be done with the aid of the sales tax shifting assumptions presented earlier in this chapter. The general retail sales tax revenue used to finance public education in Missouri and Illinois is separately analyzed, and a further analysis is made of the combined revenues of the other 46 contiguous states. By considering only actual general retail sales tax revenue, the burden resulting from any pyramiding of the tax is ignored (line 1).

The absolute dollar amount of general retail sales tax revenue utilized by Missouri, Illinois, and the rest of the United States, to finance

Fig. 8

General Retail Sales Tax Geographic Incidence Model*



*Percentages pertain to the Missouri model.
**Percentages in these boxes vary by area.

state government expenditure for public education in school year 1959-1960, was derived by multiplying direct expenditure of state governments, i.e., current operating expenditure plus debt service (Table 2), by the percentage of general retail sales taxes from the total state sales, excise, and income tax collections for 1960. General retail sales taxes comprised 56, 66 and 35 per cent of total major state tax revenue sources of Missouri, Illinois, and the remaining 46 contiguous states in 1960, respectively.[8]

Line 2 shows the point of original impact of the tax which is defined in state statutes. The original impact of the general retail sales tax rests on business firms. However, according to the concepts developed earlier in this study, the business firm is essentially a collection agent of the state, and the tax is shifted to the purchaser of goods and services. Apparently little would be gained by considering business firms according to type of establishment. We will assume that under all circumstances the entire tax is shifted.

Under Missouri law, sales of the following business firms are taxable: retail good, apparel, automotive, furniture, general merchandise, lumber and building (excluding completed construction), agricultural, natural resources, entertainment, utilities, transportation, printing and advertising, and miscellaneous. In 1960 the rate was 2 per cent.

The state of Illinois, which levies no income taxes, imposes a higher and broader based sales tax. In 1960, its general sales tax rate was 3 per cent and included sales of eating and drinking establishments, wholesalers and jobbers, and some manufacturers and producers, together with those subject to the tax under the Missouri classification. Of the other 31 contiguous states levying general sales taxes in 1960, 2 were at a rate of 4 per cent, 17 at 3 per cent, 1 at 2½ per cent, and 11 at a rate of 2 per cent. Nine states exempt retail food but in general, the taxes were limited to retail sales of tangible commodities; sales to federal, state, and local governments, and to religious and non-profit organizations, are usually exempt, as are sales to industrial consumers if destined to be a physical ingredient in a product for later sale.

Line 7a distinguishes between taxes paid by businesses on their sales and taxes paid on their purchases. To differentiate between sales to consumers and to businesses helps to determine the portion of the tax paid by people outside the state. It is assumed that taxable sales to consumers comprise 80 per cent of the total state tax receipts of Missouri and the rest of the contiguous United States, excluding Illinois, and that the remaining 20 per cent is obtained from taxable sales to businesses, all of which are in-state since interstate trade is not taxable. Only 17 per cent of sales tax collections in Illinois were assumed taxable sales to business.

Harold Groves estimated that 21.63 per cent of a proposed "typical" 2 per cent retail sales tax in Wisconsin would fall upon all Wisconsin business firms in its initial impact, which is very close to the Missorui figure. The estimates for Wisconsin business expenditures subject to tax were made on the basis of data from the 1954 Census of Manufactures, Wholesale and Retail Census publications, U.S. Department of Agriculture publication, "Farm Expenditure in 1955 by Region;" these data were supplemented by information derived from a random sample of wholesaler, retailer, and construction company income tax returns.[9] Musgrave and Daicoff estimate the amount to be approximately 15 per cent. John Due shows sales tax collections for three states — California, Illinois, and Michigan: taxable sales by wholesalers and manufacturers, plus lumber, hardware, and building materials, accounted for 25 per cent of sales tax collections in California, 17 per cent in Illinois, and 18 per cent in Michigan.[10] The relationships found in these studies of several states would seem to indicate that our distribution between consumers and businesses is not unreasonable.

Line 7b distinguishes between in- and out-of-state place of residence of consumers of the taxed goods and services in order to estimate the final geographic incidence of the tax. This is helpful in determining the location of the purchasers of all taxed goods and services by the six designated areas.

Consumer purchases are separated into those made by state residents and the rest of the United States. The Missouri State Division of Commerce and Industrial Development estimated that in 1961 about $9,860,000 in sales taxes were paid by tourists, i.e., non-residents.[11] This is approximately 10 per cent of the total Missouri sales tax receipts allocated directly to consumers; this percentage was likewise assumed to hold for the rest of the United States. The portion of the Missouri general retail sales tax paid by the St. Louis SMSA in Illinois is assumed to be zero, an apparently reasonable assumption since purchases of non-residents on charge accounts, and those delivered to out-of-state destinations, are not charged the Missouri tax. The remaining purchases by non-residents would be negligible. Thus, the Missouri tax paid by area 5, i.e., the rest of St. Louis SMSA, includes only that paid by residents of the city of St. Louis, plus St. Louis, St. Charles and Jefferson counties in Missouri.

Since goods which enter interstate trade are not taxable, the impact of the tax on business purchases falls entirely on firms selling goods for in-state trade. However, the taxes paid are entered as a cost of business operation and therefore, are shifted entirely to the in-state and out-of-state customers of these firms. In order to avoid the highly complex problem of pyramiding, it is assumed that firms sell directly to final consumers, shown in Fig. 8 as "in-state consumers" and "out-of-state consumers."

The procedure adopted first subtracts that portion of sales delivered to out-of-state destinations. The Michigan Department of Revenue took a cross section of firms and found that 55 per cent of total sales were delivered out-of-state.[12] A questionnaire survey of Wisconsin corporations indicated that approximately 80 per cent of Wisconsin's manufacturing output is sold to non-resident buyers and that about one-half the state's farm output is sold in markets outside the state.[13]

Taxes paid by businesses may not be entirely shifted forward to the consumer, if the firm participates in a national market and faces strong competition. In the sales tax models for Missouri, Illinois, and the rest of the United States, which exclude the issue of market dominance, 55 per cent of sales taxes paid by business firms on their purchases were assumed to have been ultimately borne by out-of-state residents, the balance by in-state residents (Fig. 8). Let us assume that only 40 per cent of the firms that pay state sales tax on their purchases sufficiently dominate their respective markets to warrant the supposition that they can shift these cost taxes forward by raising consumer prices and that the balance, or 60 per cent, of the firms are forced to bear the tax by reducing profits. Then the proportion of general sales taxes with an impact on businesses, which are shifted out-of-state, may be increased from 55 to as much as 82 per cent if all dividend recipients of non-dominant firms are out-of-state residents and if 55 per cent of the consumers of dominant firms are out-of-state residents,[14] for example:

out-of-state dividend recipients	60 per cent
out-of-state consumers (55 per cent of 40 per cent)	22 per cent
Total out-of-state	82 per cent
in-state consumers (45 per cent of 40 per cent)	18 per cent
	100 per cent

Although most non-dominant firms may be large and their stockholders mainly resident outside of the given state, a certain percentage of the stockholders are in-state residents. The larger the proportion of their in-state residence, the larger is the proportion of the tax shifted to dividend recipients and borne by residents of the taxing state. However, a portion of the in-state incidence upon dividend recipients would be exported out-of-state because of a reduced federal income tax liability. The above reasoning would also appear applicable for modifying the assumption that firms are able to shift to consumers all retail sales taxes *on their sales*. To the extent that firms are forced to absorb a portion of such taxes, the same classification of dominant and non-dominant firms is appropriate.

Line 8 distinguishes between sales taxes paid directly on purchases by the consumer and those paid indirectly by purchasing goods whose inputs have been taxed.

The portion of the tax paid directly by in-state consumers is distributed in the following way: it is assumed that the burden of the retail sales tax is a function of consumption expenditures. Since consumption is not a constant proportion of income, it is necessary to distribute the tax by individual income classes in the state and then by the particular areas within the state.

Estimates of the income of each income class in each of the given geographic areas, and the totals, were derived from the 1960 Census of Population. The Michigan study estimates of the effective sales tax rates paid by the various income classes in the state were applied to the total income estimates by income group to obtain the dollar amounts of their tax payments.[15] The percentage distribution of the tax was then computed for the income classes. The percentage of the tax payments for each income class in the state was distributed to each of the areas according to the proportion of the total number of income-receiving units residing in each area. The proportion allocated to each income class for each area was then summed to obtain each area's total geographic incidence.

While implementation of the Missouri sales tax model requires identifying the Missouri sales tax burden of in-state consumers by five of the case study areas, implementation of the in-state portion of Illinois sales taxes required the identification of only two areas, the Illinois portion of the St. Louis SMSA, and the rest of Illinois. None of the in-state portion of state sales taxes of the rest of the United States are a burden on residents of the case study area, Clayton, Missouri.

As was indicated earlier, the portion of Missouri sales taxes paid directly and indirectly by consumers was all apportioned to area 6, the rest of the United States. Because of the proximity of Missouri to Illinois, 10 per cent of Illinois sales taxes paid directly and indirectly by out-of-state residents was assumed borne by Missourians and was allocated among the five areas in the same proportion that in-state Missouri sales taxes were assigned. Clayton area residents were assumed to share in the out-of-state burden of sales taxes levied by the rest of the United States in proportion to its size, in terms of income recipients' weighted mean income, relative to that of the entire nation. Clayton thus comprised .02 per cent of the nation.

Line 9 identifies the major areas of geographic tax incidence. Since state taxes are deductible from taxable income under federal income tax law, an offset must be applied.

Since the geographic incidence of both an average and marginal tax is considered, the federal offset for state sales and excise taxes was computed on both an average and marginal basis.

The offset rate used for the marginal tax was computed by taking the mean income of all income recipients of an area, minus deductions computed by taking the national average by income class of total itemized deductions as a per cent of adjusted gross income, minus a flat $1,200 exemption based on total national population to national income recipients, which results in average taxable income by area. The marginal tax rate for the resulting taxable income class was taken from Schedule 1 of the Federal Income Tax Form 1040.[16]

The offset rate used for the average tax was equal to the actual income tax payment after credits, computed as a percentage of adjusted gross income for each adjusted gross income class from individual federal income tax returns filed during 1960 for year 1959.[17] The offset rate was applied to the mean income of income recipients of the area. This may slightly understate the amount of state sales taxes Clayton residents are able to offset against federal income taxes, because the average Clayton family size is somewhat less for comparable groups than the national average.

The burden of the federal offset was distributed spatially in the same manner as was that of the general property tax, i.e., in proportion to each area's contributions to total federal personal income tax collections (see Chapter III).

The allocation of the in-state portion of the sales tax paid indirectly by consumers through forward shifting of taxes by business on their purchases, is the same as the portion of the tax paid directly by consumers on their purchases, except that no federal offset is applied. No offset is applicable in the case of indirect sales taxes since neither the income of businesses is reduced (which would reduce the firm's federal income tax liability), nor the tax paid directly by the consumers (which is required in order to deduct state sales taxes when computing personal federal income tax liability).

Tax Revenue Expenditure

Within our framework, the state government acts mainly as an agency for collecting and distributing tax revenues from and to the jurisdictions under its control. Therefore, to evaluate spillovers of state financed *public education costs between jurisdictions requires knowledge* not only of the spatial distribution of state tax burden but also of the spatial distribution of state tax revenue.

The cost burden of the revenue which a state government apportions to its school districts is shared by all of the jurisdictions that contributed to this revenue. In implementing the state levied tax models, we assume, specifically, that a given jurisdiction shares in the cost of a state's revenue apportionment to all jurisdictions in proportion to its part in the total state tax burden used to finance the revenue apportionment. Thus, a portion of the revenue that a state apportions to one of its school districts is money which the district itself paid into the state public education revenue fund. The balance of the money returned to the local school district has originated in other jurisdictions in proportion to their contributions to the total state education revenue.

This methodology assumes that jurisdictions engage in a joint decision-making process, which is partly based upon economic interaction and tax shifting between jurisdictions. Even if a state apportioned its public education revenue to the impact areas of collections, to the extent that there were non-resident tourists, businessmen, students, etc., in those areas, the resulting spillover pattern is an outcome of joint decisions by area residents and non-residents.[18]

That portion of state revenue received by a district to finance its local education, which originated in other jurisdictions, is a _spillout_ of cost by the school district to these jurisdictions. Likewise, that portion of state revenue received by these other jurisdictions of the state, which originated in the given school district, is a _spillin_ of cost from these jurisdictions to the local district. The difference between cost spillout and cost spillin results in an area's net cost spillover.

Implementation of the Excise Tax Model

The excise taxes are handled in the same manner as the portion of the sales tax borne directly by the consumer. Excise taxes are applied only to purchases of taxed items by final consumers and are usually not applicable to purchases by businesses. Although the percentage of various excises paid by different family income brackets varies, the average effective rate of the two major excise taxes—cigarettes and alcoholic beverages—is very similar to that of the general sales tax throughout the income range.[19] Little would be gained in terms of greater precision of tax incidence estimates by introducing separate excise tax models.

Findings

Implementation of the retail sales and excise tax model for the state of Missouri results in separate estimates of geographic burden for both a marginal and average tax (Tables 25 and 26).

Claytonians pay 32¢ of every $100 of general sales tax revenue collected by Missouri, and 34¢ of every $100 of excise taxes collected by Missouri under the assumption of a marginal tax. They pay 37¢ and 40¢ of every $100 of tax revenue collected, respectively, for the above taxes under the assumption of an average tax.

The percentage of sales and excise taxes burden falling on Clayton from Illinois and the rest of the nation is summarized in Table 27.

In order to determine the total absolute burden on Clayton of direct operating costs of public education in the United States financed by state general sales and excise taxes, the percentage coefficients of Tables 25, 26, and 27 were multiplied by the total direct operating cost of each area (Table 2) that was financed from these tax revenue sources. The percentages which state sales and excise revenues were of 1960 total tax revenues (Table 28) were assumed to constitute their contribution to state financed direct cost. A separate analysis of Illinois sales and excise taxes was required because a major portion of the St. Louis SMSA is in Illinois. Direct current costs of this area were separated into the Missouri and Illinois portion, and the appropriate spillover coefficients were then applied.

Table 29 presents an overall summary of the Clayton School District's operating cost financed by state sales and excise taxes, the amount and spatial distribution of Clayton's cost spillout and spillin, and Clayton's

Table 25

Burden of the State of Missouri Sales and Use Taxes by Area (in percentages)

Geographic Area	Marginal Tax Model	Average Tax Model
1. Clayton School District	.322	.371
2. Rest of St. Louis County	12.719	14.387
3. City of St. Louis	11.611	13.153
4. Rest of SMSA	2.028	2.242
5. Rest of Missouri	39.991	45.323
6. Rest of United States	33.321	24.524
	100.000	100.000

Table 26

Burden of the State of Missouri Excise Taxes

by Area (in percentages)

Geographic Area	Marginal Tax Model	Average Tax Model
1. Clayton School District	.340	.401
2. Rest of St. Louis County	13.725	15.811
3. City of St. Louis	12.565	14.493
4. Rest of SMSA	2.198	2.465
5. Rest of Missouri	43.267	49.922
6. Rest of United States	27.905	16.908
	100.000	100.000

Table 27

Burden on Clayton from Illinois and Rest of the United States

General Sales and Excise Taxes (in percentages)

Area	Marginal Tax Model	Average Tax Model
State of Illinois		
General Sales Taxes	0.01400	0.012000
Excise Taxes	0.01100	0.008000
All Other States		
General Sales Taxes	0.00988	0.006780
Excise Taxes	0.00900	0.005125

Table 28

State Sales and Excise Tax Revenue as a Percentage of Total Sales, Excise, Personal, and Corporate Income Taxes, 1960

	Per Cent	
	Sales	Excise
Missouri	56.2	21.3
Illinois	66.2	33.8
Rest of U.S.	36.8	33.9

Source: U.S. Bureau of Census, Detail of State Tax Collections in 1961 (U.S. Government Printing Office) Tables 1 and 2, pp. 3, 9, 10, 15, 16.

net cost burden by area. Clayton experienced a substantially larger net sales and excise tax cost burden than the amount of these taxes used to finance its local education. Under both average and marginal assumptions, Clayton spilled in from three to six times as much sales and excise tax-financed operating costs of other areas as it spilled out of its own costs. The bulk of Clayton's net sales and excise tax cost imbalance, under both average and marginal assumptions, was with area 5, the rest of Missouri, and with area 6, the rest of the United States. Only minor net spillins were experienced with the other three areas. Clayton registered larger net spillins under the marginal tax assumption than under the average because, on net, the rest of the nation was able to offset more of its taxes to Clayton, due to higher tax rates, than Clayton was able to spill out.

Some Generalizations

Though much of the data refers to Missouri and Illinois, important parameters have been estimated from other data. Simulation of other tax systems would essentially involve alteration of the values in lines 7a, 7b, and 9. In states which have major exemptions for business purchases, e.g., Ohio, the 20 per cent figure in line 7a would be too large. In states which are not heavily industrialized, the out-of-state portion may be excessive. Line 9 will obviously change depending on the population and income of states. The federal offset will change with varying incomes, as a result of changes in the marginal and average tax rates.

If the assumption of 100 per cent shifting to the consumer is relaxed, the model would more closely resemble that of the real property tax. Line 2 would be subdivided to account for possible differences in shifting ability.

Table 29

Clayton School District Burden of Direct Operating Costs Financed by State Sales and Excise Taxes (in $000)

Area	Sales Tax Average	Sales Tax Marginal	Excise Tax Average	Excise Tax Marginal
1 (Clayton)	$ 0.4	$ 0.3	$ 0.1	$ 0.1
2-6 (Spillout)	97.9	97.9	37.0	37.0
TOTAL	$ 98.2	$ 98.2	$ 37.1	$ 37.1
Spillout to:				
2	14.1	12.5	5.9	5.1
3	12.9	11.4	5.4	4.7
4	2.2	2.0	0.9	0.8
5	44.5	39.3	18.5	16.1
6	24.1	32.7	6.3	10.4
TOTAL 2-6	$ 97.9	$ 97.9	$ 37.0	$ 37.0

Spillin to Clayton of Direct Operating Costs of Other Areas Financed by State Sales and Excise Taxes

Spillin from:				
2	$ 17.7	$ 15.4	$ 7.2	$ 6.1
3	15.9	13.8	6.5	5.5
4	5.0	4.5	2.0	1.8
5	144.3	125.3	58.9	50.0
6	131.5	191.7	91.6	160.9
TOTAL 2-6	$ 314.4	$ 350.6	$ 166.3	$ 224.3
Clayton	0.4	0.3	0.1	0.1
Others	314.4	350.6	166.3	224.3
TOTAL CLAYTON	$ 314.8	$ 350.9	$ 166.4	$ 224.4

For example, by law utilities are able to recover 100 per cent of the tax, while a firm in a competitive market, given a differential tax, may have difficulty in doing so. However, even utilities may not be able to recover all of the tax in the short-run because of the time lapse before the regulatory commission might act to increase rates to compensate for a tax increase. In the case of the sales tax which is paid indirectly by the consumer, a differential tax in one state may place a portion of the burden on owners of businesses through output effects. Addition of lines 3 through 6 to the present model, without altering the assumption of a 100 per cent forward shift, does not affect the final geographic incidence. However, varying the assumption of 100 per cent forward shift necessitates inclusion of lines 3 through 6 because geographic incidence would change. Differences in residence of the owners of corporate versus non-corporate firms, and differences in federal income tax offsets of these firms, will change the final geographic incidence.

It may be desirable, furthermore, to split the model into two portions: one containing metropolitan areas which border another state and the other, the remainder of the state. The reason for this division is that state tax differentials may become important in border areas of large populations because of the opportunity to evade taxes and the resulting competitive pressure on firms in the higher taxing state to absorb the tax differential. The geographic incidence of the tax would differ from that of areas where firms are not under such pressure.

Chapter VI

IMPUTED OPERATING COSTS

Introduction

In the preceding chapters we have been concerned almost exclusively with the more obvious operating costs of public schools, that is, direct or explicit operating costs, which show up, in one form or another, on a private or public balance sheet as accounting costs explicitly relating to education. However, there are education operating costs that tend to escape the not-too-careful eye. These are the imputed or indirect costs which are not registered as accounting costs directly relating to education on any private or public balance sheet. Nevertheless they are incurred and constitute a bona fide resource opportunity cost.

The dichotomy of direct versus imputed costs holds not only for operating but also for capital costs and both deserve analysis. This chapter will concern itself with an examination of imputed operating costs and their spatial spillover. Imputed capital costs will be taken up in parts of the next chapter.

General and Theoretical Considerations

Imputed Operating Costs

It is useful to define imputed operating costs of education as payment for resources that are entirely consumed during an accounting period, but which are not registered on a private or public balance sheet relating explicitly to education. Among them, for example, are the earnings foregone by students during the time they attend school. In general, school attendance is compulsory in the United States by state law up to the age of sixteen. Thereafter, students are free to seek full time employment, but if they stay in school the earnings they consequently forego are an imputed education operating cost.[1]

In addition, some earnings are also foregone by parents, school board members, and others who make free time available for school affairs. School board members, for example, usually devote their time and energy to the provision of public education gratuitously because of a sense of community responsibility and pride. They make managerial decisions for public schools in the same sense as a board of directors does for the private firm. Since school board members are usually among the most distinguished and able citizens of the community, they probably forego considerable private income as a result of school board activities.[2] Likewise, parents of students probably forego some earnings through attendance at PTA meetings, or by assisting their children in homework. However, they are likely to derive psychic benefits from aiding their children, which may involve substitution for other forms of consumption. Furthermore, students and their parents incur various expenditures as a result of public school attendance. Good examples are the costs of books, school supplies, and transportation.

A further imputed operating cost relates to the direct money outlays incurred by other local, state, and federal governments in financing services that are rendered free to public schools. For example, municipalities, counties, townships, and special districts often directly provide local school districts with police and fire protection, refuse collection, roads, etc., free of charge. Even though the resource costs of municipal services are largely direct and explicit, an imputation must be made in apportioning such services provided to local school districts and to other land uses in the community. To the extent that they are about the same as for other land uses, a rough estimate of the cost of providing such services could be obtained by multiplying the municipal tax rate by the assessed valuation of school property. If the value of municipal services provided public schools is independently determined and included as a direct cost of providing public education, no cost should be imputed to reflect the municipal tax-exempt status of school property; this would result in double counting.[3]

Finally, thought must be given to the imputation of interest for the use of current resources during an academic period. Current resources used in the provision of public education are analogous to circulating capital, inventory, or short-term assets of a private firm. In both instances, an interest cost is incurred by not converting current resources into cash and earning interest on current bank savings deposits. An interest cost should be imputed in theory for all categories of current resources utilized in the provision of public education—direct expenditures of the school district, foregone earnings of students, miscellaneous costs to students and parents resulting from school attendance, and municipal services rendered free to schools.

One might object to imputing an interest on foregone earnings because it requires a double imputation. Foregone earnings, however, can be regarded as an investment in human capital since this investment is expected to yield returns in future years. Thus, foregone earnings should be treated in the same way as other current costs. This approach is consistent with the methodology used by Jacob Mincer to estimate aggregate investment through on-the-job training, in which he measures investment by earnings foregone (plus interest) in alternative activities.[4]

No future period interest cost, however, should be imputed on current foregone earnings because of the discounting procedure. The present value of such future interest on current foregone earnings is zero when an identical interest rate is used both to impute interest on principal and to discount the imputed interest into present value.

Spillover of Imputed Operating Costs

The imputed operating costs of public education spill over community boundaries when non-residents of the providing community incur part of the ultimate cost burden. Within a federated system of government, in which more than one level makes decisions with respect to public education, the individual is a legal resident of more than a single government unit. Although individuals may be residents of the same county, township, or municipality, they may be residents of different school districts. For example, if two school districts are located within the same municipality, but one is provided with more municipal services than the other, the municipal service costs of the high service district may in large part be spilled over to residents of the low service district, since residents of both districts share equally in municipal service costs. Federated governmental relationships greatly complicate spillover patterns as more units and levels of government are included in the analysis.

Individuals may be residents of a single school district, but of a different county, township, or municipality. If these governmental units provide the school district with varying levels of service which are shared by all school district residents, the municipal service cost of the school districts' public education will be shared unequally by district residents, even though no municipal service cost has spilled over the school district boundary. Thus, the smaller the physical and population size of the elemental unit of analysis, the more likely are spillovers of imputed operating costs to be found between the units.

Intercommunity imputed cost spillovers are difficult to evaluate for two reasons. Not only must their magnitude be imputed, but the spatial incidence must also be evaluated under altered institutional arrangements which would translate imputed into direct costs.

The spillover aspects of some of the more important types of imputed public education costs will now be examined in relation to the Clayton School District.

Empirical Imputed Operating Cost Spillover Model for Clayton Spillouts

In this portion of the discussion we shall present estimates of the magnitude of some major imputed cost spillouts resulting from the provision of public education in the Clayton School District in 1959-1960. They will be examined in the following order: (1) foregone earnings of students, (2) miscellaneous costs to students and parents resulting from school attendance, (3) municipal services rendered free to schools, and (4) imputed interest.

Foregone Earnings of Students

The earnings which students forego while attending school are assumed incurred in the community of their residence. Foregone earnings cost spills out of a community when non-resident students attend that community's public schools, and foregone earnings cost spills in to a community when students residing therein attend school elsewhere. Once a student drops out of school and joins the labor force, he no longer foregoes income as a result of education and the possibility of his out-migration from the community does not generate imputed cost spillovers. Income foregone by parents of non-resident students, likewise, is an imputed cost spillover. Since school board members are legally required to reside within the community they serve, any foregone earnings cost is consequently incurred within the same community.

Most state school-attendance laws require students to remain in school until they are 16 years of age. This legal framework is used for estimating foregone earnings, recognizing that individuals of less than 16 years forego earnings in a less restricting legal setting. In order to derive estimates of foregone earnings cost comparable to the estimates of the additional earnings that accrue later in life as a result of current education, all students are assumed to have found full-time employment once they joined the labor force. This assumption abstracts from the actual situation in the St. Louis County area labor market.[5] For consistency, we assume that all Clayton High School juniors and seniors are able to find full-time summer employment. Therefore, the estimate of full-time earnings foregone apply only to the academic school year. To the extent that wage rates for summer employment are less than on an annual basis, the assumption understates foregone earnings.

A factor that would decrease the estimates of earnings foregone is the amount students earn while attending school. A recent Bureau of Labor Statistics report indicates that in the fall of 1959, 22.6 per cent of all enrolled students in the United States, aged 14-17 years, were employed and working an average of 11.4 hours per week.[6] White students enrolled in school in the St. Louis SMSA in 1960 revealed a similar employment experience.[7] Part-time earnings, which would be unavailable if the student were employed on a full-time basis, should be subtracted from foregone full-time earnings.

There were 145 non-resident students enrolled in Clayton public schools for the school year 1959-1960, 40 of whom were 11th and 12th graders.[8] A significant proportion of these non-residents were children of Clayton School District non-resident staff members, who may send their children tuition-free to Clayton public schools. Since tuition payments were not included as revenue-cost sources, for consistency, all students were assumed Clayton residents. Consequently, there is no cost spillout of Clayton School District foregone earnings cost.

The Division of Employment Security, Missouri State Employment Service, has tabulated wage rates for typical occupations in manufacturing industries for the St. Louis, Missouri area in September, 1962.[9] This tabulation included induction wage rates for male and female for each coded occupation. It was possible to take an unweighted average of the induction wage rates of twenty occupations in manufacturing industries for male and female for which no definite skill is required (Table 30). High school youths of the 11th and 12th grades without definite skills could qualify for such work.

The direct foregone earnings of Clayton High School juniors and

Table 30

Induction (Youth) Wage Rates for Typical Occupations in St. Louis, Missouri, Manufacturing Industries, September, 1962

Occupations and Codes		Induction Wage Rate	
		Youth - Male	Youth - Female
1-01.41	Inventory Clerk	$1.45 Hr.	$1.45 Hr.
1-05.01	Clerk, General Office	1.25	1.15
1-17.01	File Clerk	1.25	1.15
1-18.43	Receptionist	—	1.00
1-18.63	Order Clerk II	1.25	1.25
1-25.64	Tabulating Machine Operator	1.30	1.15
1-25.22	Duplicating Machine Operator	1.25	1.10
1-25.41	Addressograph Machine Operator	1.15	1.10
1-33.01	Secretary	1.70	1.65
1-34.04	Receiving Clerk	1.25	1.15
1-34.13	Shipping Clerk	1.15	1.00
1-34	Car Checker	1.15	1.00
1-37.12	Stenographer	1.65	1.60
1-37.32	Typist (40-45 WPM)	1.45	1.15
1-38.01	Stock Clerk	1.15	1.15
1-45.01	Grain Weigher	1.25	—
2-86.20	Porter and Charwoman	1.15	1.15
2-95.30	Elevator Operator	1.22	1.18
8-14	Laborer (Textile)	1.15	1.15
8-59	Laborer (Leather)	1.15	1.15
9-16	Painter, spray (Any ind.)	1.15	1.15
	Average	$1.27 Hr.	$1.19 Hr.

Source: Division of Employment Security, Missouri State Employment Service, Youth Services, "Wage Rates for Typical Occupations in Manufacturing Industries," unpublished statistical tabulations 24-1, (St. Louis, Missouri, September, 1962).

seniors may be computed by multiplying the wage rate (male and female) times 1,600 hours (40 hours per week times 40 weeks per year) times the number of boys and girls. Total foregone earnings thus computed equal $601,440.

Part-time foregone earnings must be subtracted from the full-time foregone earnings. It was assumed that 22.6 per cent of the students work part time for an average of 11.4 hours per week for a 40 week academic year.[10] It was found that in the School and Community Work Related Program of Central High School in the city of St. Louis, for the school year 1960-1961, high school juniors and seniors participating in this program earned an average of 95 cents per hour for part-time work of about 22 hours per week.[11] Based on this wage rate, and the above assumptions of part-time work participation, it was found that a total of $30,068 was earned through work by all students in attendance at Clayton High School. Subtracting the part-time foregone earnings from the full-time results in a total net foregone earnings cost of $571,372.

Miscellaneous Costs to Students and Parents Resulting from School Attendance

The direct cost of books, supplies, and travel to and from school can be calculated according to the procedure used by Schultz.[12] Schultz's estimates, however, were based on total high school students. Expenditures for these items were estimated at $28,569, or 5 per cent of $571,372 earnings foregone by Clayton High School juniors and seniors.

Municipal Services Rendered Free to Schools

Municipalities provide services to school districts for which, by virtue of their tax-exempt status, they do not pay. Among such services are streets, police and fire protection, health services, parks and recreation, library, sanitation, and sewage. For some school districts, certain municipal services may not be relevant. Health services and refuse collection, for example, are provided by the Clayton School District.

If the government services provided school districts were pure public goods, i.e., did not give rise to marginal costs, there would be little reason to apportion government service costs to them. However, most services provided by municipal governments generally increase marginal costs, although it is difficult to allocate costs to individual units. We can assume that they may be allocated on an average cost basis, and include all current expenditure costs of those services in the analysis (Table 31); implicit costs appear to be negligible. Current expenditures on municipal services by the city of Clayton in 1959-1960 were obtained from Clayton's *Annual Budget*, 1962-1963. Half of the municipal costs assigned to the school district were assumed spilled out of the district on the basis of property estimates derived from the empirical general tax model for Clayton, 1959-1960.

Streets. In a highway planning study of the St. Louis area, it was found that of 2,476,903 trips made in 1957, school was the destination for 74,077.[13] It is assumed that the same proportion applies to Clayton. However, the number of school-oriented trips includes not only those to public but also to private schools. Therefore, it is necessary to adjust the number of school trips by those destined for private and parochial schools.[14] The proportion of total street expenditure which is public school-oriented is assumed equal to their ratio to total trips.

Police. It was assumed that police protection costs could be allocated to the Clayton School District on the basis of time and equipment used in Clayton School District property relative to the total use. The

Table 31

Cost of Clayton Municipal Services Allocated to Clayton Public Schools by Function (1959-1960)

Function	Amount
Streets	$ 3,308
Police	12,918
Fire	815
Health	0*
Parks and Recreation	27,929
Library	2,750
TOTAL	$47,720

*No services rendered by city

allocation was made on the basis of a tabulation of police crime reports.[15]

Parks and Recreation. The city of Clayton Park and Recreation Department provides a summer recreation program in conjunction with the Clayton School District. Its cost is borne by the park and recreation department. The value of the service to the school district has been estimated from park and recreation department records for 1955.[16]

Library. Provision of public education results in a demand for library services, part of which is currently satisfied through their provision by the school district. Were the school district also to satisfy the rest of demand currently provided by the municipal government, one would expect school district imputed cost to increase approximately by the amount that municipal expenditures would decline. If the municipality is more efficient than the school district in the provision of this service, municipal expenditures would tend to understate its opportunity cost to the school district. It was estimated that approximately 5 per cent or $2,750 of Clayton municipal library expenditures were attributable to the Clayton School District in 1959-1960.[17]

Fire. The cost of a school district's fire protection may be thought to include only the direct costs incurred by actual trips to school property for inspection and fire fighting. However, fire protection provides an insurance protection service when the trucks and men are not in use. Therefore a substantial part of the costs of fire protection may be relative to the insurance aspect of the service. In addition, there are costs incurred by the rest of the community because the space occupied by the school hinders the movement of fire fighting equipment. In the extreme case, an additional fire station may be required because of the size and location of public school property, or at least travel time from the fire station to some areas will be increased, decreasing the quality of protection rendered. It was estimated that a minimum of $815 of Clayton municipal fire protection costs were incurred in relation to Clayton School District for 1959-1960.[18]

Imputed Interest

Imputed interest on current resource expenditure can be thought of as the amount of interest earned during a year by placing total current expenditures in bank savings deposits at the beginning of a year period; this revenue is then available to reduce local property taxes for financing other services. The spatial incidence of a tax decrease is assumed the same as of a tax increase. Imputed interest cost can be distributed according to the spatial pattern of local property tax burdens.

Imputed interest was calculated on all four components of Clayton School District current resource expenditure for 1959-1960: school district operating expenditure, foregone earnings of students, school-related costs of students and parents, and municipal services rendered free to the school district.

The question of the appropriate rate of interest to be used for public sector imputations has drawn the attention of numerous scholars.[19] We have arbitrarily used 3.5 per cent, the 1959-1960 market rate of interest on high grade school district bonds, as the opportunity interest rate cost.[20] School district bonds are purchased voluntarily by investors after considering the virtual absence of risk and tax-free advantages of such securities. Since school districts can command funds at low rates of interest, the estimates of imputed interest which follow are conservative estimates of the opportunity cost of these funds in the private sector.

The Clayton School District incurred an imputed interest cost on $1,753,121 of total 1959-1960 current expenditures.[21] At a rate of 3.5 per cent, a total of $61,359 of interest revenue was foregone during that year, which could have been used to reduce general property tax rates. No double counting results because Clayton School District earns some interest on its short-term cash balances. Such earnings are included under miscellaneous revenue and are not part of general property tax revenue, which is the determinant of local direct expenditure in the empirical analysis.

Imputed interest on foregone earnings of Clayton students in 1959-1960, using an interest rate of 3.5 per cent, amounts to $19,999. In a perfect labor market, in which there is pure and perfect competition among firms in buying labor services and likewise pure and perfect competition workers in selling labor services, wage rates would reflect marginal productivities; they would include imputed interest on current earnings. We assume that induction wage rates of high school youths are paid at the end of each working period, and do not include interest on earnings, and therefore, that the imputation is a bona fide social cost, without double counting.

Imputed interest on school related costs of students and parents, plus municipal services, is estimated as $2,671 for Clayton School District in 1959-1960.

Summary

Estimates of total imputed costs of providing public education by the Clayton School District in academic year 1959-1960, and the amounts spilled over into other geographic areas, are summarized in Table 32. Of the $731,690 total imputed operating costs, $55,263 or 8 per cent, was spilled

Table 32

Imputed Cost Spillout of Clayton School District, 1959-1960

	Cost Burden by Geographic Area							
	1	2	3	4	5	6	Total	
	Clayton School District	Rest of St. Louis County	City of St. Louis	Rest of SMSA	Rest of Missouri	Rest of U.S.	Imputed Cost	Cost Spillout
A. Foregone Earnings of Students	$571,372	—	—	—	—	—	$571,372	—
B. Miscellaneous Costs to Students and Parents	28,569	—	—	—	—	—	28,569	—
C. Municipal Services	23,908	$12,365	$1,269	$1,207	$463	$8,508	47,720	$23,812
D. Imputed Interest								
1. Current Expenditure	30,742	15,837	1,601	1,503	509	11,167	61,359	30,617
2. Foregone Earnings of Students	19,999	—	—	—	—	—	19,999	—
3. Costs to Students and Parents	1,000	—	—	—	—	—	1,000	—
4. Municipal Services	837	434	44	42	16	298	1,671	834
Total Imputed Interest	$52,578	$16,271	$1,645	$1,545	$525	$11,465	$84,029	$31,451
Total Imputed Cost	$676,427	$28,636	$2,914	$2,752	$ 988	$19,973	$731,690	$55,263

out of Clayton and became a public education cost burden to the five other areas included in the analysis.

Spillins

While the Clayton School District spilled out imputed cost burdens to the rest of the United States, resulting from the provision of public education in 1959-1960, the rest of the United States spilled out part of its imputed 1959-1960 education cost burden to Clayton School District residents. This is Clayton's cost spillin, which will be taken up under the same four headings as the spillouts.

Foregone Earnings of Students

Earnings foregone by students, as a result of senior high school education provided by the rest of the United States, are a cost to Clayton residents to the extent of their attendance in senior high schools throughout the rest of the United States. With the exception of two students who attended the city of St. Louis O'Fallon Technical High School, Clayton School District has no record of any of its residents enrolled in other community public senior high schools in academic year 1959-1960. Since the district paid their tuition, they are counted as having attended Clayton Public High School. Although 7 per cent of Clayton School District enrollment included non-residents in 1959-1960, less than 2 per cent of the enrollment of the rest of the school districts of St. Louis County were non-residents. For these reasons, we assume that 100 per cent of Clayton residents in public high school in 1959-1960 attended Clayton Public High School, or the Clayton School District paid their tuition if there were enrollees in another district's high school. We therefore also assume that there was no spillin of student foregone earnings cost in Clayton during the period 1959-1960.

Miscellaneous Costs to Students and Parents Resulting from School Attendance

Because of closer personal ties between fellow students and teachers, senior high school students are probably more inclined to finish the public school year in their area of former residence, if their parents migrate, than are primary or junior high school pupils. We assumed that all Clayton resident, public senior high school students attend school in Clayton, and it is an even likelier assumption that all Clayton resident, public elementary and secondary school students attend school in Clayton. We therefore also assume that no miscellaneous costs incurred by parents or students, such as books, supplies, or travel, as a result of public education provided in other communities, are borne by Clayton residents, i.e., spilled into Clayton.

Municipal Services Rendered Free to Schools

School districts throughout the United States are the recipients of municipal government-type services in the course of provision of public education during an academic year. In rural as opposed to urban areas, municipal government-type services, police and fire protection, public health, libraries, etc., are provided by government jurisdictions other than the municipality, which may be the county township, or special service district. To achieve a comparable treatment of the spillin of these government service costs with their spillout, we consider only those government services provided the Clayton School District in the analysis of spillin and spillout. All local government expenditure on the designated services is included in the analysis and estimate of cost spillin; state and federal government expenditures are excluded since they probably benefit different local school districts in varying proportions and also utilize different tax bases which result in different patterns of spatial incidence.

To the extent that other local governments provide more services to their school districts than do the city of Clayton and St. Louis County for the Clayton School District, by their exclusion we tend to understate the cost spillin burden of such services upon Clayton residents. Services such as sanitation, water, and refuse collection, which the Clayton School District either provides for itself or for which it pays the rendering government explicitly, are sometimes supplied free to the school district in other areas. Lacking specific information, these services are not included in the estimates.

In order to estimate the proportion of local government expenditures on the six services included in the analysis in 1960, incurred on behalf of the public schools, it was first necessary to estimate the magnitude of total expenditure on the services in that year by the six geographic areas of concern. Total expenditure in 1960 for streets and highways, police and fire protection, public health, parks and recreation, and libraries is available only for Clayton and the city of St. Louis.[22] It was therefore necessary to estimate total expenditure for 1960 in the other areas by projecting 1957 Census of Governments expenditure information. Since all cities in the United States with populations over 25,000 increased total expenditure by 21.94 per cent between 1957 and 1960, with some fluctuation between functions, and since the total expenditure of the city of St. Louis increased 19.18 per cent during this same period, a flat 20 per cent increase was applied to the expenditures by function of the remaining four areas. Total expenditure includes both current plus capital outlay. Capital outlay is taken as a rough approximation of capital consumption (depreciation) during the period of analysis (Table 33).

It was necessary to estimate the portion of total expenditure on each of the six services by area which was incurred as a result of service provided to the public elementary and secondary schools. Two independent methods were used in making these estimates.

The first method utilized the proportions of those expenditures made by the city of Clayton on behalf of the Clayton School District, with some adjustments for certain services. Specifically, it was assumed that the percentage of total Clayton police and fire protection and library expenditure, allocated to Clayton public schools, was also allocated to public schools throughout each of the five other areas. The proportion of Clayton street and highway expenditure apportioned to education was applied to each of the five other areas. However, the figure was adjusted for the proportion of public school enrollment to total public plus private school enrollment (Table 34). It was assumed that the five other areas disbursed only 10 per cent of park and recreation expenditure in support of public education, less than half of the proportion spent by Clayton. The city of St. Louis allocated approximately 5.90 per cent of its total health service budget to child guidance and other children's services. The same proportion of health service expenditure was allocated as support of public education in the remaining four areas.[23] The result of this allocation is summarized in Table 35.

A second method of allocation was used as a check on the order of magnitudes of the first. It is based on the assumption that the proportion of total expenditure to be allocated to public education on each service

Table 33

Estimated Total Local Government Expenditure on Municipal-Type Services by Area, 1960

(in $000, columns 1-5)

Service	Clayton School District	Rest of St. Louis County	City of St. Louis	Rest of SMSA	Rest of Missouri	Rest of U.S. (Million $)
Streets and Highways	$175.5	$11,085.3	$ 9,460.8	$9,727.2	$24,948.0	3,473.8
Health	21.8	1,047.4	2,488.8	177.6	2,402.4	357.5
Police	215.1	3,861.3	14,776.8	2,388.0	10,852.8	1,515.9
Fire	130.9	3,039.5	7,789.2	2,017.2	6,577.2	952.4
Parks and Recreation	118.1	1,747.9	8,319.6	1,628.4	5,006.4	712.8
Library	55.0	1,873.0*	2,056.0	832.0*	1,834.4	232.1

*These estimates were based on the assumption that per capita library expenditure in St. Louis County is the same as St. Louis City, that per capita expenditures in the Missouri portion of the St. Louis SMSA is the same as average Missouri State per capita expenditure, and that the per capita expenditure of the Illinois portion of the St. Louis SMSA is the same as the Illinois State average per capita library expenditure.

Source: The City of Clayton, Missouri, Annual Budget Document for the Fiscal Year 1962-63; U.S. Department of Commerce, Bureau of the Census, Compendium of City Government Finances in 1960, and 1957 Census of Governments: Local Government Finances in Standard Metropolitan Areas, Vol. III, No. 6, and Compendium, Vol. III, No. 5

Table 34

Public-Private School Enrollment by Area - 1960

Area	Total Public and Private	Public	Public as a per cent of total
Clayton School District	2,413	1,521	63.03
Rest of St. Louis County	166,432	111,891	67.23
City of St. Louis	139,965	100,504	71.81
Rest of SMSA	139,907	111,435	79.88
Rest of Missouri	573,680	522,430	91.07
Rest of United States	40,260,466	34,759,674	86.34

Source: U.S. Bureau of the Census, County and City Data Book, 1962 and U.S. Census of Population, 1960: General Social and Economic Characteristics, U.S. Summary, Final Report PC (1)-1C, (Washington: U.S. Government Printing Office, 1962).

Table 35

Total Expenditure on Municipal Services Allocated to Public Schools by Area in 1960*

Service	Clayton School District	Rest of St. Louis County	City of St. Louis	Rest of SMSA	Rest of Missouri	Rest of U.S.
Streets and Highways	$3,308	$208,923	$203,123	$232,317	$679,302	$89,674,285
Police	12,918	232,064	888,086	143,519	652,253	91,105,590
Fire	815	18,845	48,293	12,507	40,779	5,904,880
Health	0	61,797	146,805	10,478	141,742	21,092,500
Parks and Recreation	27,929	174,790	831,960	162,840	500,640	71,280,000
Library	2,750	93,650	102,800	41,600	91,720	11,605,000
Total	$47,720	$790,069	$2,221,067	$603,261	$2,106,436	$290,662,255
Shifted to Clayton Residents	Percent	1.2223	1.3236	0.6955	0.3717	0.0203
	Amount	$9,657	$29,398	$4,196	$7,830	$59,004

Total Spillin = $110,085

*Based on Clayton municipal expenditures by area is equal to the total value of public school property owned by an area's local school district divided by the total net stock of wealth or tangible assets of the area, excluding military. On the average, public schools probably require more services than other categories of property because of the large number of children per unit of property value. One would therefore expect the second allocation to result in a lower level of actual government service expenditure incurred in support of public education.

Estimates of the proportion of each area's total wealth—corporate-unincorporated, profit-non-profit organizations, together with total government, but excluding military wealth—in the form of local school property were based on 1956 relationships, which were assumed to have remained unchanged in 1960. The book value of public school property, as stated by the administrative units of the six areas of interest, was assumed to reflect its opportunity cost value. Book value is based on original cost plus cost of all additions and alterations, adjusted for insurance and replacement cost. The school property values of each area are summarized in Table 36.

The total net stock of wealth in each of the six areas, excluding military assets, was estimated by computing the total assessed value of property for each area, subject to local general property taxes as of November 1, 1956. These assessed values were then translated into 1956 market values (assuming assessed value equals 30 per cent of market). These values were multiplied by the ratio of total national wealth in the United States (excluding military assets) in 1956 to the market value of all property subject to general property taxes (Table 37). The proportion of estimated public education wealth of local school districts to

Table 36

Estimated Value of Public School Property of Local Basic Administrative Units, by Area, 1955-1956

Clayton School District	$ 6,625,000
Rest of St. Louis County	83,328,568
City of St. Louis	76,666,487
Rest of SMSA	92,528,452*
Rest of Missouri	364,311,494
Rest of United States	22,258,540,000

*St. Charles and Jefferson county estimate based on Missouri State average value of public school property per student enrolled, and the St. Clair and Madison county estimate based on Illinois State average value of public school property per student enrolled; in each case, the estimate was adjusted by the ratio for each county's current expenditure per student enrolled divided by the state average.

Source: Fifth Annual Report of the St. Louis County, Missouri, Public Schools for the School Year 1955-56; Board of Education of the City of St. Louis, One Hundred Second Annual Report for the Year Ending June 30, 1956; U.S. Office of Education, Statistics of State School Systems: 1955-56, and Biennial Survey of Education in the United States—1954-56.

Table 37

Estimates of Total Wealth (Excluding Military Assets) by Area, 1956 ($000)

Area	Property Subject to Local General Property Tax: Assessed Value (1)	Property Subject to Local General Property Tax: Market Value= (1)÷ .3 (2)	Total Wealth (2) x 1.6237 (3)
Clayton School District	$ 70,652	$ 235,507	$ 382,392
Rest of St. Louis County	963,873	3,212,910	5,216,802
City of St. Louis	1,713,892	5,712,973	9,276,155
Rest of SMSA	1,443,815	4,812,717	7,814,408
Rest of Missouri	3,951,531	13,171,770	21,387,003
Rest of United States	272,348,300	907,827,453	1,474,039,436

Source: Fifth Annual Report of the St. Louis County, Missouri, Public Schools for the School Year 1955-56; U.S. Bureau of the Census, 1957 Census of Governments, Taxable Property Values in the United States, Vol. V, Table 2; Raymond W. Goldsmith, The National Wealth of the United States in the Postwar Period, A Study by the National Bureau of Economic Research, New York (Princeton: Princeton University Press, 1962), Table A-1.

estimated total wealth of each area in 1956 was as follows:

Area	Public Education Wealth as a Per Cent of Total Wealth
Clayton School District	1.73251
Rest of St. Louis County	1.59731
City of St. Louis	0.82649
Rest of SMSA	1.18408
Rest of Missouri	1.70342
Rest of United States	1.51004

Table 38 summarizes the value of municipal-type service expenditure allocated to public education, utilizing the above percentages as the proportions of total expenditure to be so apportioned.

The absolute burden resting upon Clayton residents of these municipal-type services provided public schools in the five areas in school year 1959-1960 was estimated by multiplying the percentage of general property tax burden shifted to Clayton residents by these areas in 1959-1960 (Table 10) by total expenditures on these services apportioned to public schools for the six municipal services considered, and the spillin to Clayton residents under the two alternative methods, are summarized in Table 39. The allocation of municipal services to public schools, according to wealth, results in a spillin to Clayton of only $36,190 as opposed to $110,085, when they are allocated according to services directly performed for public schools, the method finally used in this study.

Imputed Interest

Imputed interest cost on current operating expenditures of areas 2-6 is also spilled into Clayton (Table 40). We assume that a 3.5 per cent

Table 38

Municipal Services Allocated to Public Schools

Basis: $\frac{\text{Public Education Wealth}}{\text{Total Wealth of Area}}$

Service	Clayton School District	Rest of St. Louis County	City of St. Louis	Rest of SMSA	Rest of Missouri	Rest of U.S.
Streets and Highways	$ 3,041	$177,067	$ 78,193	$115,178	$424,969	$52,455,770
Police	3,727	61,677	122,129	28,276	184,869	22,890,696
Fire	2,268	48,550	64,377	23,885	112,037	14,381,621
Health	378	16,730	20,570	2,103	40,923	5,398,393
Parks and Recreation	2,046	27,919	68,761	19,282	85,280	10,763,565
Library	953	29,918	16,993	9,852	31,248	3,504,803
Total	$12,413	$361,861	$371,023	$198,576	$879,326	$109,394,848
as % Direct Allocation	26.0%	45.8%	16.7%	32.9%	41.7%	37.6%
Spillin Clayton		$ 4,415	$ 4,926	$ 1,368	$ 3,358	$ 14,003

Total Spillin = $36,190

Table 39

Summary of Municipal Service Expenditure by Area,
Apportioned to Public Schools,
And Spillin upon Clayton

	Direct Service Apportionment		Wealth Apportionment	
Area	Total	Clayton Spillin	Total	Clayton Spillin
	(1)	(2)	(3)	(4)
Clayton School District	$ 47,720		$ 12,413	
Rest of St. Louis County	790,069	$ 9,657	361,861	$ 4,423
City of St. Louis	2,221,067	29,398	371,023	4,911
Rest of SMSA	603,261	4,196	198,576	1,381
Rest of Missouri	2,106,436	7,830	879,326	3,268
Rest of U.S.	290,662,255	59,004	109,394,848	22,207
Total		$110,085		$36,190

Table 40

Imputed Interest on Total Current Expenditure, 1959-1960, for Elementary And Secondary Day Schools (in $000) by Area*

Area (1)	Total Current Expenditure 1959-1960 (2)	Implicit Interest (2) x 3.5% (3)	Percentage Spilled into Clayton** (4)	Absolute Amount Spilled into Clayton (5)
Rest of St. Louis County	$ 41,610,988	$ 1,456,385	1.2223	$ 17,801
City of St. Louis	32,529,575	1,138,535	1.3236	15,070
Rest of SMSA	35,966,017	1,258,811	0.6955	8,755
Rest of Missouri	160,151,365	5,605,298	0.3717	20,835
Rest of U.S.	12,051,133,934	421,824,688	0.0203	85,630
Total	$12,322,391,879	$431,283,717		$148,091

*Total Current Expenditure, 1959-1960 (Table 2)

**see Fig. 1

rate of interest is foregone on all current 1959-1960 expenditure for public elementary and secondary education in areas 2-6. An implied assumption is that all public education revenue is collected at the beginning and valued at the end of the period. As a result, the amount of resources tied up in current expenditure is not likely to be overestimated. Negligible interest earnings are realized by local school districts on short-term cash holdings. Taxpayers, likewise, probably forego interest earnings to maintain sufficient liquidity in contemplation of local school taxes. Current resource is thus effectively withheld from alternative productive uses for the entire academic period.

Since it was assumed earlier that no foregone earnings or miscellaneous costs were incurred by Clayton resident parents or students as a result of public education provided in other communities, no imputed interest charge was made for such current resource costs. An imputed interest charge of 3.5 per cent was made against total current expenditure on municipal services allocated to public schools in each of the five geographic areas of analysis (Table 35); the absolute burden of this imputed interest charge in the school year 1959-1960 resting on Clayton residents was estimated by multiplying the imputed interest by the percentage of general property tax burden shifted to Clayton residents by these areas in 1959-1960 (Table 11).

Total imputed cost spillin to the Clayton School District, 1959-1960, is summarized in Table 41. Approximately 56 per cent of the estimated $262,029 of total imputed cost spilled into Clayton originated in the rest of the United States, about 17 per cent originated in St. Louis City, with the remaining 27 per cent shared about equally in origin between the rest of St. Louis County and the rest of Missouri.

Table 41

Imputed Cost Spillin of Clayton School District, 1959-1960

Imputed Cost	Rest of St. Louis County	City of St. Louis	Rest of SMSA	Rest of Missouri	Rest of U.S.	Total Cost Spillin (Areas 2-6)
A. Foregone Earnings of Students	—	—	—	—	—	—
B. Miscellaneous Costs to Students and Parents	—	—	—	—	—	—
C. Municipal Services	$ 9,657	$29,398	$ 4,196	$ 7,830	$59,004	$110,085
D. Imputed Interest						
1. Current Expenditure	17,801	15,070	8,755	20,835	85,630	148,091
2. Foregone Earnings of Students	—	—	—	—	—	—
3. Cost to Students and Parents	—	—	—	—	—	—
4. Municipal Services	338	1,029	147	274	2,065	3,853
Total Imputed Interest	18,139	16,099	8,902	21,109	87,695	151,944
TOTAL IMPUTED COST	$27,796	$45,497	$13,098	$28,939	$146,699	$262,029

Net Spillover

Table 42 presents a summary view of the Clayton School District's net balance of imputed public education cost spillovers for 1959-1960 by area. Clayton spilled out $55,263 of these costs but had $262,029 spilled in, with a resulting net cost spillin of $206,766. Clayton incurred net cost spillins with all areas except the rest of St. Louis County, with which it had a net spillout of $840. Of Clayton's $206,766 net cost spillin, over 60 per cent was with the rest of the United States, 20 per cent with the city of St. Louis, and the remaining 20 per cent with the rest of Missouri, and the SMSA.

Table 42

Summary of Imputed Cost Spillovers of Clayton School District, 1959-1960

	By Area					
	2.	3.	4.	5.	6.	
Clayton School District Cost	Rest of St. Louis County	City of St. Louis	Rest of SMSA	Rest of Missouri	Rest of U.S.	Total Cost (Areas 2-6)
I. Spillout (+)	$ 28,636	$ 2,914	$ 2,752	$ 988	$ 19,973	$ 55,263
II. Spillin (-)	-27,796	-45,497	-13,098	-28,939	-146,699	-262,029
III. Net Spillover (I + II)	+ 840	-42,583	-10,346	-27,951	-126,726	-206,766

Chapter VII

PUBLIC EDUCATION CAPITAL COSTS

Introduction

Capital costs constitute a substantial portion of overall public education costs. In 1957, American school districts invested nearly $2.2 billion in capital facilities, an amount which approaches 23 per cent of total direct costs. In the same year, school districts paid a total of $234 million in interest charges on over $9 billion in outstanding debt.[1] These national magnitudes in a rough way indicate the quantity of resources committed to educational facilities in a year and the volume of indebtedness which citizens are willing to bear to provide them.

General and Theoretical Considerations

In earlier chapters of this study the spatial distribution of annual operating costs, arising from the provision of education by one school district in a single year, have been described and examined. In addition to these operating costs, the school district incurs costs associated with its use of buildings and equipment. Some of these capital costs may appear in the expenditure reports of the district, but the use of such reports would not yield a complete and accurate picture of capital costs. Buildings and equipment are long lived; the expenditure report may show a large sum spent on capital facilities one year and then fail to indicate any further capital expenditures for decades, while the building is in use. If the building was financed by bonds, annual reports may include expenditures for interest on debt; but the period of indebtedness is often shorter than the life expectancy of the building. For all these reasons, those who make decisions with regard to public education often do not have a useful concept of capital costs and virtually never have appropriate data. The data most commonly used pertain to either annual capital investments or annual debt service charges by school districts. These data refer to expenditures and profitably could be replaced in the analysis by an annual capital cost of education. Furthermore, not unlike operating costs, capital costs can be divided into direct and imputed costs, depending upon their presence in, or absence from, public or private balance sheets specifically related to the capital costs of education. The general nature of capital costs favors a further dichotomy. Both direct and imputed annual capital costs involve not only an annual capital consumption cost but also an annual interest cost.

In order to facilitate the presentation of the capital cost concepts and their empirical estimation, the discussion will proceed in the following two steps: first, annual capital consumption and annual interest cost concepts will be developed; thereafter, direct and imputed elements of these two capital costs will be examined. Only after this had been accomplished will cost spillover aspects be analyzed.

Annual Capital Costs

The nature of annual capital consumption and annual interest costs, which make up total annual capital costs, can be illustrated in the following manner.

Consider a school district suddenly confronted with 500 new students. The district is assumed to be operating at capacity, with no additional facilities available. To house classes for these new students, the district contracts to rent an entire office building, agreeing to provide its own maintenance, special school equipment, etc. The owner of the building will charge the district a rental to compensate him for (1) the change in the value of his property during the contract period, i.e., an annual capital consumption cost or depreciation charge, and for (2) the income he could have earned had he sold his building and invested the returns in, for example, stocks or bonds, i.e., an interest charge.

What is the nature of annual capital consumption costs and how can they be estimated? Tentatively, capital consumption costs for a given year are defined as the reduction of future services from a capital facility occasioned by the existence and employment of the facility in that year. Three factors are involved in capital consumption: (1) material deterioration—the weakening, fragmenting, and decomposing of the material of which the facility is constructed; (2) utilization—employment of the facility for the purposes of a specified activity; and (3) random destruction—unexpected damages incurred by violent acts of man or nature.

A school district provides for parts of these capital consumption costs in its operating budget, financed from current revenues. Thus, maintenance expenditures may be determined annually to restore the anticipated capital value consumed by utilization. Likewise, annual premium payments provide insurance compensation in the event of random destruction. Such a program will tend to prevent net capital consumption from exceeding the value of material deterioration. Capital consumption costs then equal the reduction of future services from a capital facility resulting from its material deterioration in a given time period.

Material deterioration is the chief determinant of a facility's useful life. Other factors—for example, obsolescence—may be incorporated in the price-quality index to be discussed below. The measurement of material deterioration is complex and difficult. Estimates of the useful life of a facility, based upon experience and expectation, are more common.

A school facility's useful life depends upon that of the following three elements: (1) site—the land upon which the structure is located; (2) shell—the durable structure in which an activity takes place; and (3) equipment—the durable goods used in the conduct of the activity (in schools, for example, classroom desks, laboratory appratus, etc.). Differential useful lives exist for each of these elements. A site may be thought to have a useful life of infinite duration and will not enter into the computation. The life of a shell may vary from a decade or less to centuries. Equipment can be divided into groups with useful lives varying from one year to several decades. Thus, the estimation of a capital facility's useful life involves a composite weighting of shell and equipment.

School capital facilities frequently are built in stages. As a community grows or the concept of an adequate school building changes, new sections may be added to older buildings or major alterations may be made. Likewise, the equipment of a school building can be augmented or modified as needs and tastes change. Any given facility may be composed of parts of varying ages, constructed or installed in periods of dissimilar price levels. Under these conditions it is difficult to estimate the value of the entire facility at a given point in time. This problem may be approached by asking what would be the cost of construction, remodeling, addition, or equipment today comparable to that provided in past periods. Each historical cost is then adjusted by a price-quality index to provide current price data. Optimally, this index included adjustments for changes in the technology of school construction (materials, methods, and factor proportions), in school site costs, and in quality, which do not result from material deterioration. In this manner an adjusted current value of all the components of the facility is obtained on the assumption that they all were new.

However, in fact, the age of separate parts is likely to vary and, furthermore, initially they may have possessed different useful lives. Thus, each part must be weighted by the remaining percentage of its expected useful life. The sum of these weighted adjusted costs yields the current value of the facility.

With the aid of the estimate of the current value of the facility it is possible to obtain the annual capital consumption cost. Continuing to assume straight line depreciation, the useful life of the entire facility next can be estimated by summing the weighted useful life of each of its components by the ratio of its current value to the current value of the entire facility. Then, by dividing the current value of the facility by its useful life, the current capital consumption cost is obtained.

In brief, the annual capital consumption cost of a facility is a portion, determined by its useful life, of the undepreciated value of the facility in current prices, adjusted for quality changes.[2]

The direct and imputed elements of annual capital consumption costs correspond to the annual principal repayment of school district bonds and to the difference between the annual amount of capital consumption and the annual repayment of principal.

Although annual principal repayment may appear in the balance sheet of a school district, that sum is not necessarily the direct annual capital consumption cost. The practice of repaying principal prior to the consumption of the facility leads to a disparity between consumption costs and debt retirement allocations.

As Table 43 indicates, annual principal repayment may be related to either current consumption or education in a different time period outside the purview of this study. Three cases are distinguished: (1) When annual capital consumption costs equal annual principal repayment, the cost is solely direct and no other time periods are involved. (2) When annual consumption costs are greater than principal repayment, the taxes raised for the latter are entered as direct costs; the excess of annual capital consumption costs over annual principal repayment is an imputed cost. (3) When annual capital consumption costs are less than annual principal repayment, the direct cost equals this consumption cost while the portion of taxes retiring bonds in excess of consumption costs is related to a different time period.

The second part of capital costs is the annual interest cost. The school district's investment in buildings and equipment designed for educational purposes has a cost equal to the return which would have accrued to the owners of those facilities had other channels of investment activity been chosen.

Table 43

The Relationship of Annual Capital Consumption Costs to Annual Principal Repayment

WHEN	DIRECT	IMPUTED	Costs not related to current education will be equal to
	Annual Capital Consumption Costs will be equal to		
Annual Capital Consumption Costs EQUAL Annual Principal Repayment	Annual Principal Repayment	----	----
Annual Capital Consumption Costs are GREATER than Annual Principal Repayment	Annual Principal Repayment	Annual Capital Consumption Costs minus Annual Principal Repayment	----
Annual Capital Consumption Costs are LESS than Annual Principal Repayment	Annual Capital Consumption Costs	----	Annual Principal Repayment minus Annual Capital Consumption Costs

The owners of school capital are of two categories: bondholders and taxpayers. To the extent that the facilities are represented in the outstanding bonds of the district, bondholders can be considered owners. The interest which is paid by the district to bondholders represents the best alternative return on the invested amount. Bondholders may be assumed to purchase school district bonds voluntarily, after adjusting their rate of intertemporal preference for the near absence of risk in school debentures and the tax-free status of such securities.[3] The assumption is made here that the interest rate at the time the bonds were issued is equal to the current rate.

However, the outstanding debt of the district is often less than the value of its capital facilities. This disparity results from the difference between the length of time for which bonds are issued, usually 20 years,[4] and the most frequently assumed life of buildings, which is fifty years.[5] A non-linear depreciation schedule, by which buildings are assumed to depreciate at a decreasing rate, will reduce the magnitude of this disparity. With the standard straight-line depreciation practice, the interest paid to bondholders represents only part of the total annual interest costs of the capital. The difference between the value of the district's capital and that portion represented by outstanding debt is the equity of the district. The owners of this equity—the taxpayers—bear an interest cost reflecting the intertemporal preference rates of individuals.

The interest costs which are paid by the district to bondholders are direct costs, appearing separately or as part of debt service charges on the district's annual financial statement. Interest costs associated with the district's equity are absent from such statements and require imputation.

Table 44 briefly summarizes the framework established in the preceding pages. Direct costs are composed of annual principal repayment amounts, but not more than the annual consumption cost, and the annual interest payments on outstanding debt. Imputed costs consist of the excess of annual consumption costs over the annual principal repayment, and the annual interest on the school district's capital equity.

Spillover of Annual Capital Costs

In the previous section two major types of direct annual capital costs and imputed annual capital costs, respectively, were identified and examined. In this section, the intercommunity spillover characteristics of these capital cost elements will be analyzed.

The spatial distribution of annual capital consumption costs is related to the repayment of the principal of a school district's bonds. If an answer was sought to the question, "Who bears the costs of education in a given year?", the burden of capital consumption, as measured by tax payments for debt retirement, would be found to fall upon residents of the past, present, or future. Then there would be a need to identify the tax revenues used to repay the debt, the tax shifting pattern at the time of the levy, and the residency of persons in the present time period who have borne, or will bear, the tax burden.

The above question and discussion differs from the direction of this inquiry. In the context of a decision-making model for a local school board, the relevant question becomes, "What will be the effects of a given decision to provide education in this year?" Past time periods

Table 44

The Direct and Imputed Division of Annual Capital Consumption and Annual Interest Costs

	Annual Capital Consumption Costs	Annual Interest Costs
Direct Costs	Annual Principal Repayment (not in excess of annual consumption costs)	Annual Interest on Outstanding Debt
Imputed Costs	Annual Consumption Costs minus Annual Principal Repayment	Annual Interest on Capital Equity

cannot be affected by the present. Thus, it is not possible to rely upon debt repayment exclusively in identifying the spatial distribution of consumption costs.

The spatial distribution of direct consumption costs, which are either equal to, or less than, the annual sum of principal repayment, can be distributed spatially according to the spatial burden of the type of tax raised for debt retirement. For example, if bonds are retired exclusively from taxes on real property, then the spatial distribution of the burden of this tax will yield the spatial burden pattern for direct consumption costs. If bonds are retired by taxes raised on both the local and state level, then the more complex spatial patterns of these taxes must be employed.

The spatial distribution of direct interest costs is, likewise, a product of the patterns of the taxes raised to pay the annual interest on outstanding bonds. Thus, for the portion of the district's capital stock represented by bonded indebtedness, the burden of direct interest costs will coincide with the spatial distribution of burden realized from the district's particular sources of revenue.

In the case of imputed consumption costs, the burden allocated to individual areas may be considered as part of an unpaid rental on the school facilities. The spatial pattern may be derived from the pattern that could be expected to arise if this imputed cost were made explicit or direct. Again, if the district derives its revenue from, say, the real property tax exclusively, the spatial pattern of the purden of that tax would provide the area's distribution of the imputed annual consumption cost.

A similar line of reasoning is employed for the imputed annual interest cost. The spatial distribution of this cost, representing an interest charge for the portion of the district's capital stock held as equity, is derived from the tax burden pattern which would arise were this cost made explicit.

Empirical Spatial Spillover Analysis of Capital Costs for Clayton

Public school property in the United States in the school year 1959-1960 was valued in excess of $37 billion.[6] Of this sum, based on historical costs and insurance evaluations, only part is consumed or depreciated in a single year. At the same time, there are interest costs associated with the retention of capital in the service of public education. In the following pages the spatial spillovers of the annual costs related to this capital stock will be estimated. First, the spillout of capital costs from Clayton will be examined, followed by an analysis of their spillin into Clayton.

Annual Capital Costs and Their Spillout from Clayton

In the school year 1959-1960, the Clayton School District owned and operated fourteen buildings, including administrative quarters and athletic facilities. The reported value of all sites, buildings, and equipment, based on depreciated historical cost and insurance values, was in excess of $7.6 million.[7] In this section the spatial distribution of the costs associated with this capital stock by the provision of education in Clayton will be estimated.

Assumptions. The following assumptions were made in estimating the capital costs of education provided by Clayton: (1) Material deterioration is the sole cause of the depreciation of the district's capital facilities. Maintenance and insurance premiums, paid out of the current operating budget, are assumed to cover capital consumption resulting from utilization and random destruction. (2) Sites are excluded from the estimates of capital consumption because they have infinite useful lives. (3) Equipment is excluded from the consumption estimates because its value is small relative to the total value of public school property—only 5 per cent of public school capital in Missouri in the school year 1957-1958 was equipment.[8] (4) All capital outlay on structures—initial construction, additions, and renovations—are financed by debt issue. In the period 1906 through 1960, less than 3 per cent of capital outlay was financed from the current revenues of the Clayton School District.[9] (5) The useful life of a capital facility is assumed to be fifty years. Clayton officials use an estimate of forty-five to fifty years. Renovations and additions are assumed to extend the useful life of a facility by fifty years, weighted by the relationship of the renovation or addition to the existing facility. (6) Straight line depreciation is assumed. (7) Historical costs are assumed adjusted to the 1960 price-quality level by deflating costs with a construction cost index. The apartments, hotels, and office buildings (including schools) component of the E.H. Boeckh Historical Construction Cost Index was utilized for the period 1915-1960. The Building Materials Wholesale Price Index of the Bureau of the Census was spliced to the Boeckh Index for the period 1907-1915.[10]

Direct annual capital costs. The method of estimating the capital consumption of the physical plant of the Clayton School District follows the discussion of capital consumption costs above. From data provided by the district the capital consumption costs in 1960 of each of the fourteen buildings were determined. Table 45 presents the estimated values, useful lives, and capital consumption costs for these facilities. For example, the Gay Building, constructed in 1953 with supplementary work in 1960, was valued at about $164,000 with a useful life of over forty-three years. Dividing the 1960 value by the estimated useful life yielded the estimate of nearly $4,000 as the 1959-1960 capital consumption cost of the Gay Building. The current value of all buildings was estimated to be in excess of $5.5 million; the average useful life of Clayton facilities was found to be 37.70 years; the capital consumption costs for 1960 exceeded $157,000.

During the period from July 1, 1959, to June 30, 1960, the Clayton School District retired $175,000 of its nearly $2.3 million bonded indebtedness. Thus, the district repaid principal in excess of current capital consumption. The $175,000 sum results from the contractual period of indebtedness and is not the cost of education in the current time period. In effect, in the year 1959-1960, the district added approximately $18,000 to its equity; it may be considered to have bought $175,000 in capital facilities from bondholders, of which it consumed $157,000. In the framework of Table 43, direct capital consumption costs were $157,000 and the costs not related to current education were $18,000.

The spatial distribution of direct annual capital consumption costs was obtained by applying the spatial tax burden patterns of the revenues of the Clayton School District. With 90 per cent of the district's revenues coming from local property taxes and 10 per cent from state sources (Table 2), nearly $142,000 was financed from the former and almost $16,000 from the latter. Each revenue source's spatial incidence pattern was applied to its associated costs. For example, 50.10 per cent of the local Clayton property taxes are a burden to Clayton residents (Table 9). Applying this percentage to the portion of direct annual capital consumption costs associated with local property taxes, the burden upon Clayton residents was found to be $71,000. Table 46 presents the direct annual capital consumption costs according to the revenue source associated with their financing and the burdens upon residents of each of six geographic areas. Clayton residents bore $71,000 or 45 per cent of the burden of these costs. The next largest burden was borne by residents of the rest of St. Louis County (area 2), nearly $40,000 or 25 per cent of the total cost.

In the school year 1959-1960, the Clayton School District paid interest charges on bonds amounting to $47,824. This payment represented the direct interest cost of the capital investment of the district. The sum was a return to bondholders equal to the return available from the next best investment. Spatially the burden of this cost is coincident with the distribution of the taxes raised to pay the interest charges. In Table 47, the spatial distribution of the direct annual interest cost burden is shown. Clayton residents bore nearly $21,000 of the total direct interest cost.

In total, Clayton residents paid nearly $93,000 of the more than $205,000 direct annual capital costs associated with the provision of public education by the district in the year 1959-1960. Table 48 indicates the total burden of the district's direct capital costs borne each of the six geographic areas.

Imputed annual capital costs. In the preceding section it was found that the Clayton School District repaid principal sums on outstanding debt in excess of the estimated capital consumption cost for

Table 45

Annual Capital Consumption Costs of the Clayton School District, 1959-1960

Building	Date of Construction, Renovation, Addition (1)	Current (1959-1960) Depreciated Value (2)	Estimated Useful Life (3)	Annual Capital Consumption Costs (4)
Bellevue School	1906, 22, 31, 51	$173,561.72	21.94 years	$ 7,910.74
Bracken Bldg.	1941, 54, 57	153,139.59	35.38	4,328.42
DeMun School	1927, 29, 45	228,073.02	18.79	12,138.00
East Field House	1931	32,472.36	21.00	649.45
Gay Bldg.	1953, 60	164,302.01	43.54	3,773.59
Glenridge School	1929, 31, 32, 34, 45, 57	362,817.63	24.70	14,688.97
Glenridge Kg. House	1953	75,824.22	43.00	1,763.35

Table 45: part ii

	(1)	(2)	(3)	(4)
High School Bldg.	1952, 56, 58, 59	2,558,120.76	43.21	59,202.05
Maryland School	1930, 54, 57	325,829.60	25.46	12,797.71
McMorrow School	1952, 53, 57, 58	641,252.89	44.62	14,371.42
Meramec School	1938, 47, 51, 56 58, 60	563,241.88	38.01	14,818.26
West Field House	1930, 31, 37, 60	22,029.68	23.63	932.28
Wydown Gym	1937, 49	165,422.08	27.12	6,099.67
Wydown School	1917, 37	91,873.06	23.03	3,989.28
TOTAL CLAYTON DISTRICT		$5,557,961.40	Average 37.70 years	$157,463.19

Source: Special computations from data compiled by the Clayton School District.

Table 46

Spatial Distribution of Clayton School District Direct Annual Capital Consumption Costs for the School Year 1959-1960, by Area

($000)

	Revenue Source			
Geographic Area	Local Property Taxes	State Sales and Excise Taxes (Average Model)	State Income Taxes (Average Model)	Total
1. Clayton School District	71.0	*	.1	71.1
2. Rest of the St. Louis County	36.7	1.8	1.0	39.5
3. City of St. Louis	3.8	1.6	.5	6.0
4. Rest of SMSA	3.6	.3	.1	3.9
5. Rest of Missouri	1.4	5.7	1.3	8.4
6. Rest of United States	25.3	2.7	.5	28.5
Total**	141.8	12.2	3.5	157.5

* Indicates a burden of less than $50

** Figures may not add to totals because of rounding

Table 47

Spatial Distribution of Clayton School District Direct Annual Interest Costs for the School Year 1959-1960, by Area ($000)

	Revenue Source			
Geographic Area	Local Property Taxes	State Sales and Excise Taxes (Average Model)	State Income Taxes (Average Model)	Total
1. Clayton School District	21.6	*	*	21.6
2. Rest of St. Louis County	11.2	.5	.3	12.0
3. City of St. Louis	1.1	.5	.2	1.8
4. Rest of SMSA	1.1	.1	*	1.2
5. Rest of Missouri	.4	1.7	.4	2.5
6. Rest of United States	7.7	.8	.2	8.7
Total**	43.1	3.7	1.1	47.8

* Indicates a burden of less than $50

** Figures may not add to totals because of rounding

Table 48

Spatial Distribution of Clayton School District Direct Annual Capital Costs for the School Year 1959-1960, by Area ($000)

Geographic Area	Direct Annual Capital Consumption Costs	Direct Interest Costs	Total
1. Clayton School District	71.1	21.6	92.8
2. Rest of St. Louis County	39.5	12.0	51.5
3. City of St. Louis	6.0	1.8	7.8
4. Rest of SMSA	3.9	1.2	5.1
5. Rest of Missouri	8.4	2.5	10.9
6. Rest of United	28.5	8.7	37.2
Total*	157.5	47.8	205.3

* Figures may not add to totals because of rounding

the year 1959-1960. As noted in that discussion, and following the framework of Table 43, the excess of $18,000 in principal repayment was a cost not related to education in the current year. Principal repayment fully covered the capital consumption costs of the year and no imputed annual capital consumption costs were present.

Imputed interest is a cost to the residents of the community during the period the capital facilities were utilized for the provision of public education. If the community were confronted with having to rent its capital facilities from a profit-making corporation, tax rates would increase to raise the additional revenue required to cover the imputed interest cost. Therefore, the burden of the imputed interest cost is assumed borne geographically according to present intercommunity general tax shifting patterns.

The 1959-1960 current depreciated value of buildings, as computed in Table 45, was over $5.5 million. Assuming that this represents 72 per cent[11] of the school district's capital assets (the remaining 28 per cent are land and equipment), the current depreciated value of all capital assets at the beginning of the period 1959-1960 is estimated at $7,719,391. The $2,290,000 outstanding bonded indebtedness of the school district at the beginning of school year 1959-1960 was subtracted from the depreciated current value of $7,719,391, resulting in an estimate of $5,429,391 as the equity of the school district in its public education capital facilities. Using a market rate of 3.5 per cent as the opportunity interest rate, the imputed interest cost of education provided by the Clayton School District in 1959-1960 was $190,029.

The geographic distribution of the imputed interest cost, which constitutes the entire imputed capital cost, is presented in Table 49.

Table 49

Imputed Interest-Cost Spillout of Clayton School District, 1959-1960

($000)

Geographic Area	Revenue Source Local Property Taxes	State Sales and Excise Taxes (Average Model)	State Income Taxes (Average Model)	Total
1. Clayton School District	85.7	.1	.1	85.9
2. Rest of St. Louis County	44.3	2.2	1.2	47.7
3. City of St. Louis	4.6	2.0	.7	7.2
4. Rest of SMSA	4.3	.3	.1	4.8
5. Rest of Missouri	1.7	6.8	1.6	10.1
6. Rest of United States	30.5	3.3	.6	34.4
Total*	171.1	14.7	4.3	190.0

* Figures may not add to totals because of rounding

Employing the spatial tax burden pattern for Clayton revenues (as used in the allocation of direct costs) the more than $190,000 in imputed interest costs was distributed among the six geographic areas. Clayton residents bore nearly $86,000 of this sum, the burden of the remaining 55 per cent falling on residents of other areas.

Adding direct and imputed capital costs together, a summary of Table 50 indicates that Clayton residents bore less than one-half of the total capital costs for the year 1959-1960. While Clayton residents bore nearly $179,000 in capital costs, residents of other areas bore nearly $217,000 in capital costs. Thus Clayton was able to shift out capital costs equal to 120 per cent of their burden on its own residents. In the following pages this spillout of capital costs will be compared with the spillin to Clayton of similar costs from other areas.

Annual Capital Costs and Their Spillin to Clayton

Direct annual capital costs. The forty-eight contiguous states of the nation, excluding Clayton from Missouri, had capital investments valued at $37.3 billion in the school year 1959-1960. Of this sum approxmately $26.9 billion was the value of buildings. Assuming a uniform useful life for these facilities, estimated at 34 years, the 1959-1960 annual capital consumption cost approaches $791 million. In Table 51 the estimated annual capital consumption cost is shown for each of the five areas capable of spilling costs into Clayton. In the same table the amounts repaid to bondholders, retiring outstanding long-term debt, is indicated. Following the procedure outlined earlier in this chapter, direct and imputed annual capital consumption costs were derived (Table 51). In three areas principal repayment exceeded the annual consumption

Table 50

Spatial Distribution of Clayton School District Direct and Imputed Annual Capital Costs for The School Year 1959-1960, by Area

($000)

Geographic Areas	Direct Annual Capital Costs	Imputed Annual Capital Costs	Total
1. Clayton School District	92.8	85.9	178.6
2. Rest of St. Louis County	51.5	47.7	99.2
3. City of St. Louis	7.8	7.2	15.0
4. Rest of SMSA	5.1	4.8	9.9
5. Rest of Missouri	10.9	10.1	21.0
6. Rest of United States	37.2	34.4	71.6
Total*	205.3	190.0	395.3

* Figures may not add to totals because of rounding

Table 51

Annual Capital Consumption Costs and Principal Repayment Amounts

For Non-Clayton Areas, 1959-1960, by Area ($000)

Geographic Area	Annual Capital Consumption Cost	Principal Repayment	Direct Capital Consumption Cost	Imputed Capital Consumption Cost
2. Rest of St. Louis County	2,829.4	3,455.9	2,829.4	0
3. City of St. Louis	1,639.9	1,300.0	1,300.0	339.9
4. Rest of SMSA	2,787.6	3,020.6	2,787.6	0
5. Rest of Missouri	10,273.3	9,060.1	9,060.1	1,213.2
6. Rest of United States	773,339.8	807,320.0	773,339.8	0
Total*	790,870.0	824,156.6	789,316.9	1,553.1

* Figures may not add to totals because of rounding

costs, in which cases there are no imputed consumption costs. In St. Louis City and in the rest of Missouri, principal repayment was less than the annual consumption cost and an imputed cost is shown.

The direct capital consumption costs were allocated to Clayton according to the spillin percentages of the tax revenues used in each area to finance public education. In the rest of St. Louis County (area 2) local property taxes account for nearly 80 per cent of revenue of school districts; in the rest of the United States (area 6) the figure is closer to 56 per cent. For the St. Louis County area the spillin coefficient of 1.2223 was applied to this 80 per cent of consumption costs; for the rest of the United States 0.0203 per cent was applied (Table 11). Similarly, the costs associated with state sales and excise and income taxes were allocated to Clayton on the basis of the spillin coefficients (Tables 21, 25, 26, 27).

Table 52 presents the burden upon Clayton residents of direct annual capital consumption costs resulting from the provision of education in other areas in 1959-1960. This table indicates that Clayton residents bore a total of $216,000 in direct capital consumption costs of other areas. Nearly half, 48 per cent, of these costs were spilled in to Clayton from the rest of the United States. About 29 per cent of the amount spilled in was from other school districts within the same metropolitan area. The remaining 23 per cent was spilled in from the rest of the state of Missouri. Of the total spillin, nearly 75 per cent was through the financing of local school districts by the general property taxes.

The interest payments on outstanding bonds of school districts throughout the United States in 1959-1960 exceeded $437 million. Table 53 indicates the amounts of these direct interest costs spilled in to

Table 52

Spillin to Clayton Residents of Direct Annual Capital Consumption Costs, 1959-1960, by Area ($000)

	Revenue Source			
Geographic Area	Local Property Taxes	State Sales and Excise Taxes (Average Model)	State Income Taxes (Average Model)	Total
2. Rest of St. Louis County	27.5	1.7	2.7	31.9
3. City of St. Louis	13.2	.9	1.4	15.5
4. Rest of SMSA	13.7	.5	.8	15.0
5. Rest of Missouri	19.1	11.5	18.4	49.1
6. Rest of United States	88.2	14.3	2.0	104.5
Total*	161.7	28.9	25.3	216.0

* Figures may not add to totals because of rounding

Table 53

Spillin to Clayton Residents of Direct Annual Interest Costs, 1959-1960, by Area ($000)

Geographic Area	Interest Paid on Outstanding Debt	Total Direct Interest Cost Borne by Claytonians
2. Rest of St. Louis County	2,384.4	26.9
3. City of St. Louis	597.1	7.1
4. Rest of SMSA	2,281.3	12.2
5. Rest of Missouri	4,931.6	26.7
6. Rest of United States	447,126.8	60.4
Total*	457,321.2	133.4

* Figures may not add to totals because of rounding

Clayton. The spillin amounts were obtained in the same manner used for direct consumption costs, i.e., by dividing the costs of each area into separate amounts for each source of financing and applying the appropriate spillin coefficients. Claytonians thus bore over $133,000 of direct interest costs of other areas.

Table 54 combines the direct costs borne by Clayton residents for the year 1959-1960. The direct spillin amounts ranged from $165,000 (area 6) to $23,000 (area 3) and totaled over $349,000.

Imputed annual capital costs. Imputed capital consumption costs were present in only two of the five areas spilling costs into Clayton (Table 53). The total amount of direct cost which would be spilled into Clayton, were this cost made explicit, would be over $40,000. More than half of this amount would accrue to Claytonians from the rest of Missouri and more than half would be the result of local property taxation. Table 55 presents these imputed capital consumption costs in detail.

Of the $37 billion invested in the capital facilities of school districts throughout the United States, over $16 billion may be considered owned by bondholders. The districts then own, on behalf of taxpayers, over $20 billion of capital facilities. At an imputed interest rate of 3.5 per cent, this capital investment represents an imputed interest cost in excess of $727 million. Table 56 indicates the capital investment of school districts and the spillin to Clayton residents, were the imputed interest cost to be made direct. This cost would amount to nearly $200,000 for the residents of Clayton.

Table 57 presents the total amounts of direct and imputed capital costs spilled into Clayton from other districts. This table, totaling

Table 54

Spillin to Clayton Residents of Direct Annual Capital Costs, 1959-1960, by Area ($000)

Geographic Area	Direct Annual Capital Consumption Costs	Direct Annual Interest Costs	Total Direct Capital Cost Spillins
2. Rest of St. Louis County	31.9	26.9	58.9
3. City of St. Louis	15.5	7.1	22.6
4. Rest of SMSA	15.0	12.2	27.2
5. Rest of Missouri	49.1	26.7	75.8
6. Rest of United States	104.5	60.4	165.0
Total*	216.0	133.4	349.4

* Figures may not add to totals because of rounding

Table 55

Spillin to Clayton Residents of Imputed Annual Capital Consumption Costs, 1959-1960, by Area ($000)

	Revenue Source			
Geographic Area	Local Property Taxes	State Sales and Excise Taxes	State Income Taxes	Total
2. Rest of St. Louis County	0	0	0	0
3. City of St. Louis	3.4	.3	.4	4.1
4. Rest of SMSA	0	0	0	0
5. Rest of Missouri	2.6	1.5	2.5	6.6
6. Rest of United States	0	0	0	0
Total*	6.0	1.8	2.8	10.6

* Figures may not add to totals because of rounding

Table 56

Estimates of 1959-1960 Capital Equity by Area with Imputed Interest Cost Borne by Clayton Residents

($000)

	Area 2: (Rest of St. Louis County)	Area 3: (City of St. Louis)	Area 4: (Rest of SMSA)	Area 5: (Rest of Missouri)	Area 6: (Rest of U. S.)
1) Total Capital Value	$133,611.0	$77,440.9	$131,636.4	$485,129.1	$36,518,823.0
2) Bonded Indebtedness	88,861.7	26,789.0	70,191.8	206,591.6	16,159,537.0
3) Equity: (1)-(2)	44,749.3	50,651.9	61,444.6	278,537.4	20,359,286.0
4) Imputed Interest (3)x(.035)	1,566.2	1,772.8	2,150.6	9,748.8	712,575.0
5) Clayton Spillin	17.7	21.1	11.5	52.8	96.3

Total Spillin (Areas 2-6) = $199.5

Sources: U.S. Department of Health, Education, and Welfare, Statistics of State School Systems: 1955-56, 1957-58; U.S. Department of Commerce, Summary of Governmental Finances in 1959, 1960, County and City Data Book, 1962; Report of the Public Schools of the State of Missouri, June 30, 1960; Report of the St. Louis County Public Schools, 1959-1960.

Table 57

Total Capital Cost Spillin to Clayton, Missouri, 1959-1960, by Area ($000)

Geographic Area	Direct Capital Costs Spilled in	Imputed Capital Costs Spilled in	Total Spillin of Capital Costs
2. Rest of St. Louis County	58.9	17.7	76.5
3. City of St. Louis	22.6	25.2	47.8
4. Rest of SMSA	27.2	11.5	38.8
5. Rest of Missouri	75.8	59.4	135.1
6. Rest of United States	165.0	96.3	261.3
Total*	349.4	210.1	559.5

* Figures may not add to totals because of rounding

nearly $560,000 for the year 1959-1960, is comparable to Table 50 in which the total direct and imputed capital costs of the Clayton School District were presented. The comparison of the amounts spilled out by Clayton (Table 50) and the burden spilled in from other areas (Table 57) is made in Table 58. It shows that Clayton had a net spillin of nearly $237,000 of direct costs. Were the imputed costs made explicit, i.e., were they to appear in public and private balance sheets, the total net spillin to Clayton residents would approach $343,000. Clayton had a net spillout of costs only with respect to the rest of St. Louis County; this positive spillover position for Clayton, it should be noted, is obtained only from the inclusion of imputed costs. As a result of tax-financed activities (direct costs), Clayton had a negative spillover position with each area individually and with all collectively.

Table 58

Net Spillover Position of Clayton for Direct and Imputed Capital Costs, 1959-1960, by Area ($000)

Geographic Area	Net Direct Capital Cost Spillover	Net Imputed Capital Cost Spillover	Net Total Capital Cost Spillover
2. Rest of St. Louis County	-7.3	+30.0	+22.7
3. City of St. Louis	-14.9	-18.0	-32.9
4. Rest of SMSA	-22.1	-6.8	-28.9
5. Rest of Missouri	-64.9	-49.3	-114.1
6. Rest of United States	-127.8	-61.9	-189.7
Total*	-236.9	-105.9	-342.8

* Figures may not add to totals because of rounding

Chapter VIII

SUMMARY OF COST SPILLOVER FINDINGS

The magnitude and relationships of the separate components of public education costs and their spillovers will, in the present chapter, be drawn together, and their implications for policy discussed. In offering a partial framework for a policy analysis we must bear in mind that at this point in our study only tentative conclusions may be posited. For example, cost spillovers for a specific area may appear inequitable, but the magnitude of benefit spillovers may change the evaluation entirely. Further, as will be shown, policies directed at altering the patterns of cost spillovers may involve benefit mechanisms and yield results contrary to the policy-maker's intention.

The total costs of education provided by Clayton in the school year 1959-1960 approached $2.9 million (Table 59). Of this amount Clayton spilled out over $1.2 million or nearly 43 per cent. Locally financed direct operating costs (Chapter III) were nearly 55 per cent of the total cost; imputed operating costs (Chapter VI) were under half this amount.

The ability to shift the direct operating costs led to imputed operating costs emerging as 41 per cent of the Claytonians' burden of their education, while direct operating costs were reduced to 48 per cent, and direct and imputed capital costs comprised the remaining 11 per cent of the total education cost.

Table 59

Summary of Cost Spillover Findings
($000)

Costs of Clayton's Education				Cost of Education in All Areas Borne by Clayton		
Borne by Clayton	Spilled out to Other Areas	Total		From Education in Clayton	Spilled in From Other Areas	Total
			A. Direct Operating Costs financed by			
790.7	787.6	1,578.3	Local Property Taxes (Chapter III)	790.7	2,624.1	3,414.8
0.8	38.6	39.4	State Personal Income Taxes (Chapter IV)	0.8	442.5	443.3
0.4	97.9	98.3	State Sales Taxes (Chapter V)	0.4	314.4	314.8
0.1	37.0	37.1	State Excise Taxes (Chapter V)	0.1	166.3	166.4
676.4	55.3	731.7	B. Imputed Operating Costs (Chapter VI)	676.4	262.0	938.4
178.6	216.7	395.3	C. Direct and Imputed Capital Costs (Chapter VII)	178.6	559.5	738.1
1,647.0	1,233.1	2,880.1		1,647.0	4,368.8	6,015.8

Cost spillins (Table 79) added $4.4 million burden on Claytonians, bringing their total burden to over $6 million. Spillins equaled nearly 73 per cent of Clayton's total burden. Of the spillin burden, over 80 per cent was derived from state and locally financed direct operating costs.

The spatial distribution of Clayton's education costs is presented in the row or the inverted L of Fig. 9. The upper section of this Fig. is in dollar magnitudes, the lower section in percentages. The costs borne by Clayton residents from education provided by each of the several areas are shown in the column segment of the inverted L. On the diagonals are Clayton's net spillovers. The negative signs indicate reductions in Clayton's wealth, a cost borne by Claytonians; positive signs indicate increases in Clayton's wealth through cost spillovers. Fig. 9 reveals that Clayton experienced a net cost spillin totaling over $3.1 million. Therefore, with respect to costs, Clayton would have been better off in a world without spillovers. The majority (52 per cent) of this net cost spillin resulted from interaction with the rest of the nation. With its closest neighbor, the rest of the St. Louis County, Clayton had only a minor net cost spillin of $6,000. Thus, while Clayton spilled nearly 20 per cent of its education costs to the rest of St. Louis County, the dollar magnitudes of the spillovers in both directions were nearly equal.

Net cost spillovers between Clayton and the other areas had the effect of reducing before tax inter-area per capita income differentials (Table 60). Clayton, with the highest per capita income of all six study areas, realized a total cost burden equal to 3.80 per cent of its per capita income; the burden upon Clayton from net spillins was 2.49 per cent of per capita income. In terms of distributional equity, it is interesting to note that net cost spillin, as a percentage of Clayton's per capita income, changed inversely with the per capita income levels of other areas. Moreover, the positive effect of these cost spillovers upon the relatively poorer neighboring areas—3, 4 and 5—were greater than the effect upon the relatively wealthy areas—2 and 6. For the poorer group the beneficial relationship with Clayton equaled 0.01 to 0.02 per cent of per capita income, while for the wealthier the percentage was about 0.0002. Thus, Clayton's public education net cost spillover was generally consistent with a progressive fiscal policy.

Components of Cost Spillovers

The effect that cost spillout has upon the efficiency with which a community allocates resources for public education, and the effect that net cost spillover has upon the spatial distribution of per capita income directs the inquiry to a closer examination of the separate cost components. The different patterns of spillovers suggest that an individual community's concern should be with the effect of a given policy on individual components. This section will discuss the Clayton findings in terms of four major component groups: (1) nature of the inputs, (2) financing level or unit, (3) revenue source, and (4) incidence determinants.

The reader will find these four groupings to be an abbreviated statement of the overall framework initially identified in Chapter II and developed in the subsequent chapters. Within each grouping we will

Fig. 9

Summary of Clayton's Total Public Education Cost Spillover, 1959-1960, by Area

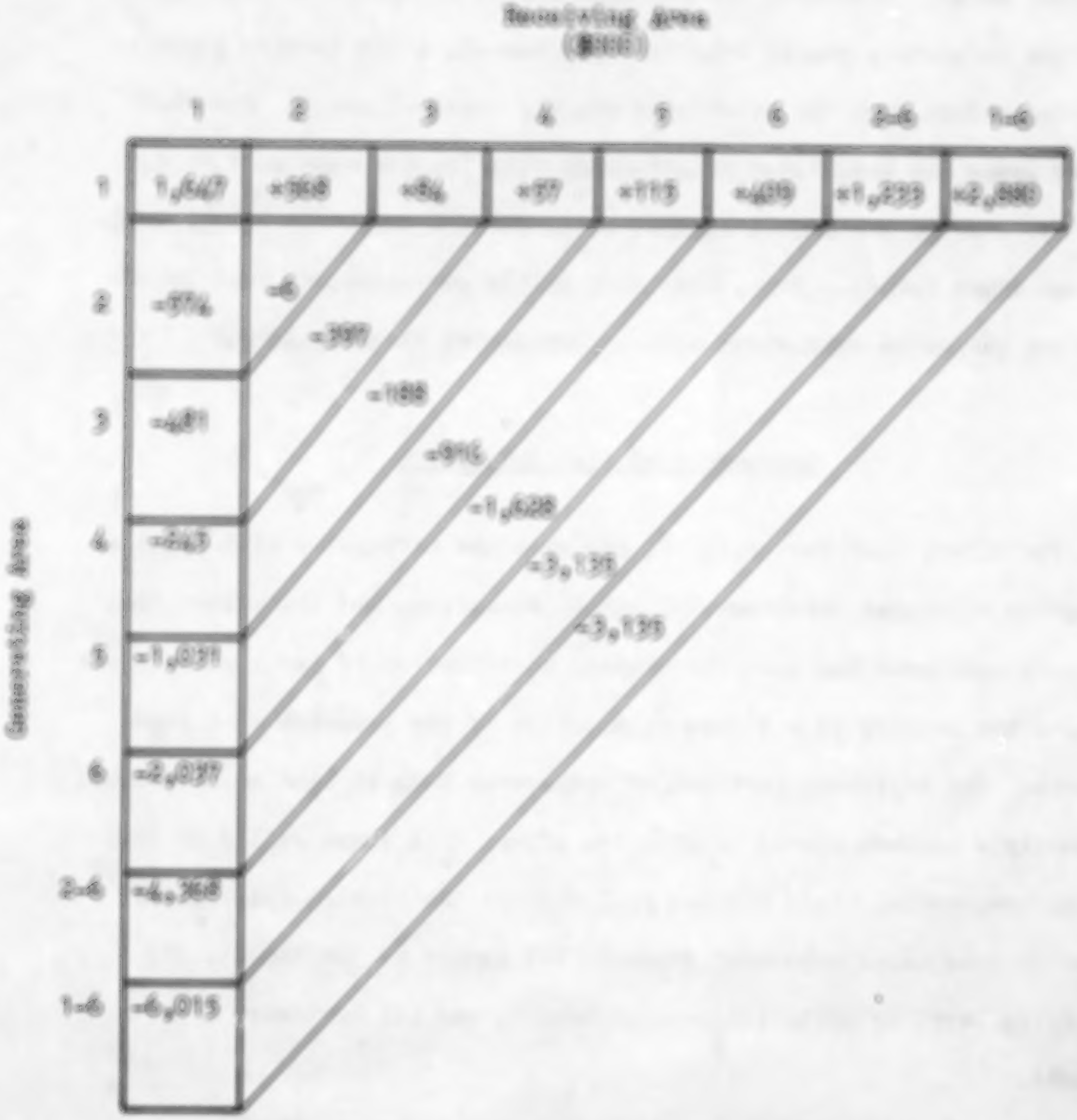


Fig. 9: part II

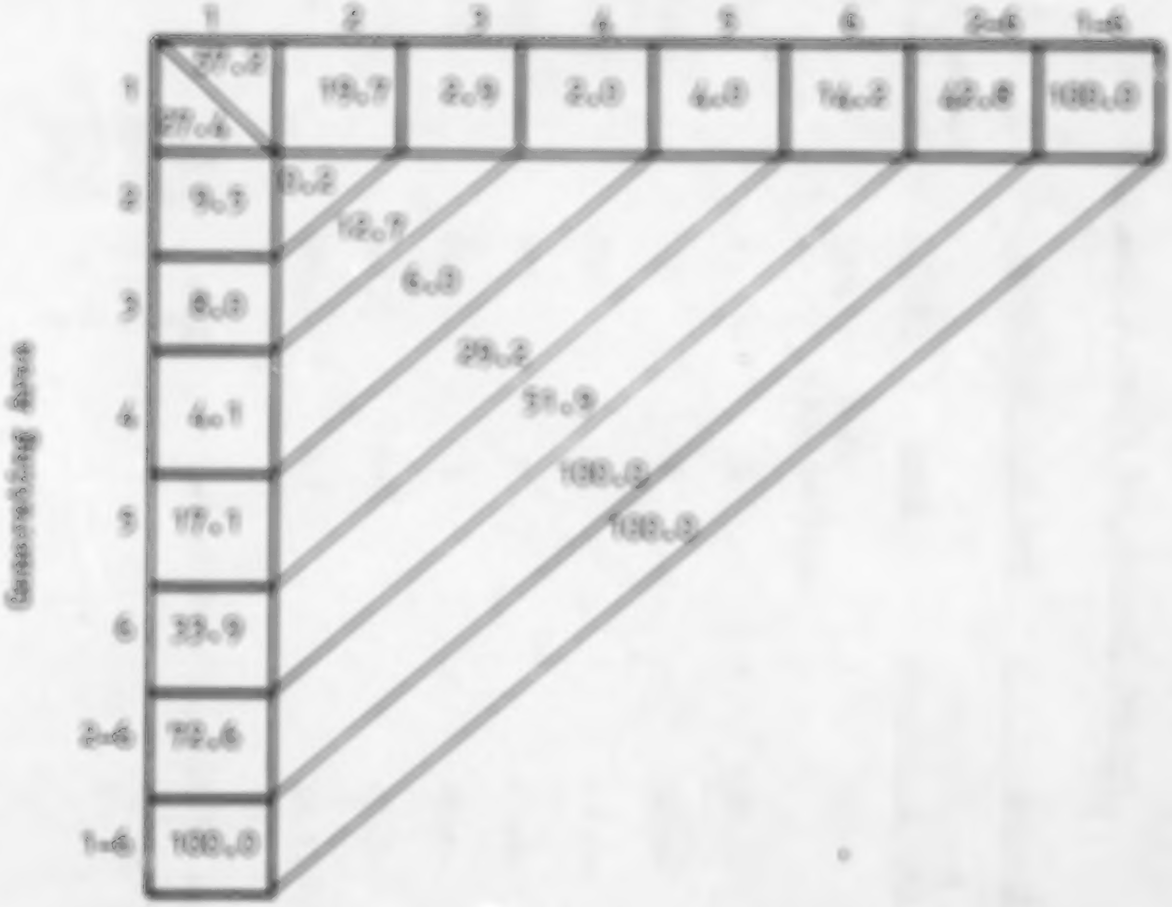

Receiving Area
(per cent)
Generating Area
1
2
3
4
5
6
2-6
1-6
27.2
27.6
19.7
2.9
2.0
4.0
14.2
62.8
100.0
9.5
8.0
4.1
17.1
33.9
72.6
100.0
0.2
12.7
6.0
29.2
31.9
100.0
100.0

Table 60

Wealth Effects of Public Education Net Cost Spillover Between Clarion and Other Areas, 1959-1960

Effect on Clarion		Net Cost Spillover		Effect on Other Areas	
Change in Per Capita Income ($)	As a Per Cent of Per Capita Income*	Area	($000)	Change in Per Capita Income ($)	As a Per Cent of Per Capita Income*
-109.80	-1.31	1(Net Spilled out)	1,647	None	None
- 0.40	-0.005	2	6	+0.01	+0.000118
- 26.47	-0.32	3	397	+0.32	+0.016
- 12.53	-0.15	4	188	+0.32	+0.008
- 61.07	-0.73	5	916	+0.33	+0.011
-108.53	-1.29	6	1,628	+0.01	+0.000027
-209.00	-2.49	2-6	3,135	+0.02	+0.000054
-318.80	-3.80	1-6	4,782	—	—

* 1960 Per Capita Income of Persons with Income

Area	$
1	8,391
2	8,317
3	2,039
4	3,888

Area	$
5	2,912
6	3,467
2-6	3,467

consider the actions a local community can take to improve its cost spillover position, and the effect of changes in the structure of inter-community relations upon cost spillover. The consequences of several of these changes for the cost burden of Clayton and other areas will be identified and, where applicable, these changes will be considered once more in later chapters with respect to benefits and the cost-benefit integration.

Nature of the Inputs

In the preceding chapters we defined those institutional factors which lead some education costs to be recognized explicitly and duly recorded as direct costs while others, which do not appear on any balance sheet, require imputation. Imputed costs clearly associated with direct costs were distributed spatially according to the same factors that lead to the allocation of the direct cost. The discussion of capital costs (Chapter VII) best illustrates this treatment. Certainly, the distinction between direct and imputed costs is of consequence in that it focuses attention upon the imputed cost factors usually neglected by decision makers, as contrasted with those mainly included by economists in their analyses.

When attention is centered on the cost spillover, we can identify four major input cost categories: (a) school district operating costs, (b) school district capital costs, (c) municipal services rendered to the district, and (d) costs borne by students and their families. This division offers four bundles of goods, which may be substituted for each other in the district's production function. To discover the spillover consequences of such substitution it is necessary to trace the financing path of an input through the model. Consider, as school boards and state governments might do, the substitution of capital facilities for labor inputs. Such a substitution would tend to be neutral in its spillover consequences. Capital costs were distributed (Chapter VII) according to the relative importance of each of the financing sources of the school district, viz., the state government and the school authority. Operating costs of the district were distributed (Chapters III through VI) in the same manner. Within this model, then, the substitution of capital for labor would fail to affect the spatial distribution of the cost burden.

Since the same spillover pattern is applicable to costs (a) and (b) above, they may be combined into one category: school district expenditure. Table 67 presents the cost burdens of Clayton's education (Columns 1 through 2) and the burden of all education borne by Clayton (Columns 3 through 5) for the six study areas by cost category. From the percentage section of Column 2 it can be seen that the assumption by the Clayton School District of costs directly borne by the family will find part of the burden shifted to other areas. Similarly, assumption by the district of costs related to municipal services will find a higher portion of costs shifted out of Clayton (35 per cent compared with 30 per cent).

There are institutional changes in policy which would have the effect of maintaining the present factor input mix at a lower cost. One could, for example, lower the entry age for children in the schools from 6 to 5; 12th graders would then be graduated at 17 rather than 18.[1] In Clayton's case, foregone earnings would be reduced by $306,300 under this plan because the 164 high school juniors now eligible for employment would

Table 61

Summary of Clayton's Total Cost Spillover by Function Expenditure Category, 1959-1960

($000)

Expenditure Category	(1) Total Cost of Clayton Education (2) + (3)	(2) Total Spillout	(3) Net Spilled Out	(4) Total Spillin	(5) Total Clayton Burden (3) + (4)
1. School District Expenditure	1,001.4	1,208.2	1,001.4	4,254.4	5,255.8
2. Foregone Earnings and Miscellaneous Family Expenditures	621.0	0.0	621.0	0.0	621.0
3. Municipal Services	49.3	24.6	24.7	113.9	138.6
Total	2,879.9	1,232.8	1,647.1	4,368.3	6,015.4

(Per Cent)

Expenditure Category	(1)	(2)	(3)	(4)	(5)
1. School District Expenditure	100.0*	54.7*	45.3* 19.1**	80.9**	100.0**
2. Foregone Earnings and Miscellaneous Family Expenditures	100.0*	0.0*	100.0* **	0.0**	100.0**
3. Municipal Services	100.0*	49.9*	50.1* 17.8**	82.2**	100.0**
Total	100.0*	42.8*	57.2* 27.4**	72.6**	100.0**

*As a per cent of column (1)　　**As a per cent of column (5) ly under the legal working age. Thus, the school district of Clayton could reduce the total social costs of Clayton's education by about 11 per cent. Since foregone earnings costs are borne within the area providing education, Clayton's burden for its own education could be reduced by about 19 per cent and its total cost burden by 3 per cent.

Financing Level or Unit

As indicated in the preceding section, the three input groups are financed by four different units: the school district, the state government, the municipal government, and the families with children in school. The first two of these finance the school district's expenditures while the latter two each have separate bundles of costs to finance. Table 62 summarizes the burden of Clayton's education by area (Columns 1 through 3) and the burden upon Clayton residents from education in all areas (Columns 3 through 5), identified by unit of finance. While the local school district financed over 60 per cent of the cost of Clayton's education, school district related costs amounted to only 61 per cent. The ability to shift part of all costs, except those related to families with children in school, altered the composition of costs to Claytonians. Of the costs shifted out 81 per cent originated with the school district. Of the costs spilled in to Clayton, 73 per cent derived from school district financing. In total, nine out of ten dollars of cost burden on Clayton originated with government units.

What are the implications of the data in Table 62 for Clayton's state aid policy. A change in the state's apportionment formula is one possible modification. Clayton, as a wealthy community, might well want an increase in the basic apportionment, which is computed on the basis of

Table 62

Summary of Clayton's Total Cost Spillover Identified by Financing Unit, 1959-1960

($000)

Financing Unit	(1) Total Cost of Clayton Education (2) + (3)	(2) Total Spillout	(3) Not Spilled Out	(4) Total Spillin	(5) Total Clayton Burden (3) + (4)
1. School District	1,995.7	995.9	999.8	3,197.3	4,197.1
2. State Government	214.0	212.4	1.6	1,057.3	1,058.9
3. Municipality	49.3	24.6	24.7	113.9	138.6
4. Student and Parents	621.0	0.0	621.0	0.0	621.0
Total	2,880.0	1,232.9	1,647.1	4,368.5	6,015.6
(Per Cent)					
1. School District	100.0*	49.9*	50.1* 23.8**	76.2**	100.0**
2. State Government	100.0*	99.3*	0.7* 0.1**	99.9**	100.0**
3. Municipality	100.0*	49.9*	50.1* 17.8**	82.2**	100.0**
4. Student and Parents	100.0*	0.0*	100.0* **	0.0**	100.0**
Total	100.0*	42.8*	57.2* 27.4**	72.6**	100.0**

*As a per cent of column (1)   **As a per cent of column (5) the number of students in the community, by decreasing the equalization portion of the state's apportionment formula, which is related to assessed valuation and other indices of an area's ability to support education. Holding the state's total school budget constant, a relative increase in the basic apportionment would allow Clayton, holding its budget constant as well, to substitute state funds for locally raised funds. As Table 62 indicates, Clayton spills out a higher percentage of state financed costs than it does of school district financed costs. Spillins would be reduced since Clayton bears a smaller percentage burden of other Missouri areas' locally financed costs than it does of Missouri state financed costs. Hence Clayton's total cost burden would be reduced.

But if the apportionment formula were kept intact and state funds were substituted for school district funds, the results would be opposite. Consider an increase in the state's school budget and a corresponding decrease in the budget of all districts within the state. Clayton's percentage of state financed cost spillout is larger than its school district financed spillouts. Although this fact alone suggests the transfer of financing from the school district to the state level, such a policy would actually prove unfavorable to Clayton; increased spillin of state financed cost of education from other districts in the state would more than offset Clayton's increased cost spillout.

For example, a general statewide one per cent substitution of state funds for school district funds would enable Clayton to increase its cost spillout by $9,859 =[$19,957 (.993-.499]. However, assuming the new policy applied to all districts of the state, Clayton would reduce school district financed cost spillin by $15,062 = .01 ($1,506,200), but would increase spillin of state financed cost from these same areas by $110,975 = [5.6($19,957 - $140)]. For every additional local education cost state financed tax dollar spilled out, $5.60 is spilled in from other districts of the state. As a result, Clayton would incur a net additional cost burden of $86,054, by encouraging such a change.

Revenue Source

The school district mainly relies for its revenue upon real and personal property taxes while the state derives most of its funds from sales, excise, and income taxes. (The municipality is assumed to employ the same taxes as the school district; the family source of financing is earnings.) Here we will examine the effects of substitution of revenue sources on the state level.

Through the balance of taxes employed by the state of Missouri, Clayton bore $774,000 for education in the entire state. The existing mix found sales taxes accounting for 56 per cent, income taxes 23 per cent, and excise taxes 21 per cent of the state's major revenue sources. Assume now that the state were to alter this mix, placing greater emphasis on the income tax (say, raising it to 30 per cent of state revenue) with a compensating decrease in sales tax revenues. Holding the state budget for education and the apportionment pattern constant, Clayton would find its total cost burden rising by $120,000 to a total of $894,000. This result is obtained from the tax burden coefficients developed in Chapters IV and V—Clayton bears 0.371 per cent of Missouri sales tax and 2.090 per cent of Missouri income taxes. Thus, under the existing revenue mix of the state, Clayton bears a total burden of $6,015,800. A change in the taxing policies of the state would raise this total burden by only 2 per cent. A similar analysis, with consequences of lesser magnitude, would be obtained from changes in the tax mix of the Clayton School District itself.

Incidence Determinants

Zoning changes can, over a period of time, affect spillovers.[2] For example, in chapter III (Table 13), we considered an increase in the relative positions of the retail and office sectors of 12.2 and 21.8 per cent, respectively, to 25 and 40 per cent, with a consequent decline of the residential sector from 66 to 35 per cent of total real property revenue. This change would enable Clayton to increase the proportion of its local property tax-financed cost spillout from 48.43 to 68.01 per cent, a net increase of 20 per cent. If Claytonians do not change their shopping and buying patterns, there is no accompanying increase in property tax-financed cost spillin. A structural change that enabled Clayton to substitute $100,000 of retail and office real property tax revenue for residential property tax revenue would thus permit Clayton to spill out an additional $20,000 of its local cost-of-education burden. Clearly, the magnitude of the change is dependent upon the magnitude of the substitution.

With a greater concentration of major retail and office facilities in the Clayton business district, and an increase in the number of major apartment buildings, the economic participation of non-Claytonians in the economy of Clayton may be expected to rise. One would assume Clayton's growth as a center of investment opportunities, drawing capital from a wider area, and also its development as a center of services for the expanded area. In Chapter III, Tables 14 and 15 reveal the extent of decrease in Clayton's tax burden which would result from a greater involvement of other areas in Clayton's economy. If the initial changes in land use zoning foster development which caters mainly to the needs of adjoining St. Louis County and St. Louis City, and if Claytonians maintain their patterns of spatial economic interaction, i.e., they continue to shop, own property, etc., in Clayton and other areas in the same proportion as previously, there is no reason to expect an increase in cost spillin to Clayton from local school districts, municipal, or state-financed cost burdens of other areas.

In many communities there also has been discussion of changing the provision for offsetting state and local taxes against income for federal income tax purposes. One faction would like to see increased offsetting of local-state taxes as a means of reducing the real cost burden on local residents of additional expenditure on their education. A larger portion of each additional dollar expended by a school district on local education would be spilled out to residents of the rest of the United States because of a compensating reduction in federal income tax liability of district residents. Such provisions would encourage local-state education expenditure initiative, and would tend to discourage financing additional costs through the federal government. In effect, local funds would tend to be substituted for federal funds by increasing the offset provision.

An opposite faction would like to see a reduction in tax offset provisions as a means of increasing the local education cost burden on community residents of additional local education expenditure, thereby reducing the burden placed upon federal funds. Consequently, the federal government would have additional revenue to finance those aspects of education which it considers most crucial. It would have additional revenue to use the financing of education to promote equal tax effort among school districts, and to encourage equal educational quality in all school districts. Because of Clayton's high marginal federal tax rate, an increase in offset provisions would tend to work to its relative advantage, while a decrease would be relatively disadvantageous.

Summary

In this chapter various preceding findings were drawn together. The reader should keep in mind the assumptions on which they are based and the nature of the data. It was noted that Clayton's education cost society about $2.9 million, of which Clayton bore only $1.6 million. However, spillovers were not favoring Clayton: about $4.4 million in costs were spilled in from other areas, bringing Clayton's total annual cost burden from education in all areas to about $6 million. Cost spillovers between Clayton and other study areas were found equitable in terms of per capita income. Not only were interarea per capita income differentials reduced, but cost spillovers had a relatively greater positive effect upon per capita income of poorer areas than upon wealthier areas—a finding consistent with progressive fiscal policy. Within the context of our partial cost analysis, it appears that Clayton can improve its net cost position by making institutional changes that mainly require local action (such as lowering the school age, in case this is possible), rather than changes in financing or zoning. Not only would changes in financing, such as substitution of state or federal for local revenue sources, require approval by residents of other areas, but an adverse effect upon a local community's benefit position may result which outweighs favorable cost effects. While major alterations in the spillover magnitudes could be effected by sizable variations in the financing and economic structure, such changes cannot be considered within the scope of our partial analysis.

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Chapter IX

INTERCOMMUNITY BENEFIT SPILLOVER ANALYSIS

The obvious counterpart to education costs is benefits; both costs and benefits affect the community's decision to provide education. What are the various benefits from public primary and secondary education; how are they spilled in and out of a particular district; who are the beneficiaries (people within the school district or people outside of it); how large are their benefits? These are the key questions examined in this part of the study.

At the outset, we must remember that education benefits differ from costs in their time horizon. While many costs are incurred during the year in which education is provided, few of the benefits are realized at that time. Also, benefits of educational capital often blend into the social fabric, forming an integral part of the culture of society, and as a result become difficult to isolate and measure. To the extent that education benefits are measurable, a lifetime investment approach is taken, discounting the stream of future benefits back to the year for which the cost analysis is made. This technique provides comparability since costs associated with the education of a single year—the budgetary period for school district expenditure decisions—can be examined and compared with benefits related to the same period.

What are the major benefit elements of education? First, there are those aspects of education which increase production potential, such as improved skills and capabilities of students. Second, there are those aspects which make possible the total or partial reallocation of resources. Only those resources used for education that have an alternative market value are included in this study. Table 63 summarizes the social benefits of education.

General Framework for Benefit Spillover Analysis

We should remember that our spillover analysis is carried out within a decision-making framework, with the school district as the crucial unit. Let us also recall our definition of intercommunity benefit spillover: any portion of the benefits resulting from public education provided in one school district ultimately realized by residents of another. Benefits can flow spatially in both directions, into the school district (spillins) and out of it (spillouts). Benefit analysis is symmetrical and therefore the following discussion applies to flows in both directions.

Within a local government decision framework, the school district where the beneficiary resides when an education decision is made is the decisive factor in evaluating effects of cost and benefit spillovers. Insofar as benefits that occur within the market are concerned, those which accrue directly to students and their (present) families do not spill over. This applies both to short- and long-run direct benefits. However, indirect benefits—those which accrue to non-student households—can spill over. The reasons are two: migration and fiscal interdependence. More will be said about them below.

The formal classification of benefits and their spillover has been summarized in Fig. 10, in the same way as the earlier cost classification. The terms "direct" and "indirect" in the benefit analysis are not comparable to the terms "direct" and "imputed" in the cost analysis. All benefits are

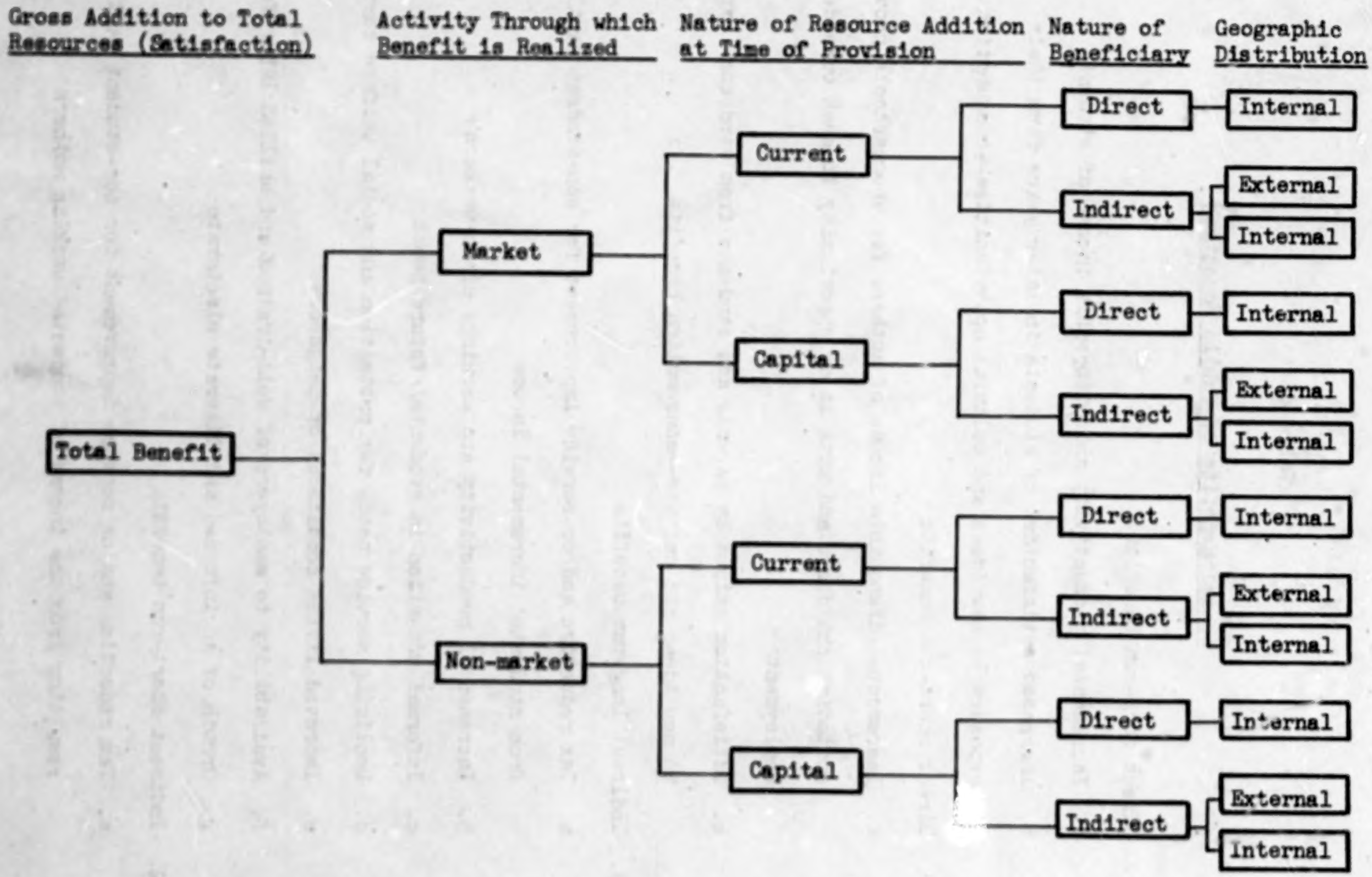
Table 63

Social Benefits of Public Education

1. Direct long-run benefits
    - a. Incremental productivity and disposable income of students
    - b. Increased satisfaction of students in later years from their exposure to new ideas and cultural opportunities—consumption benefits
2. Direct short-run benefits
    - a. Incremental disposable income of mothers for whom schools provide custodial childcare and with it an opportunity to seek outside employment
    - b. Satisfaction gained by parents and students from students' exposure to new ideas and culture—consumption benefits
3. Indirect long-run benefits
    - a. Tax reduction and/or service improvement for non-student families from students' incremental income
    - b. Incremental productivity and earnings of co-workers
    - c. Informal education in students' future homes
    - d. Declining service needs for protection and social welfare services
    - e. Improved living conditions of neighbors
    - f. Availability to employers of well-trained and skilled labor force
    - g. Growth of an informed and literate electorate
4. Indirect short-run benefits
    - a. Tax reduction and/or service improvement for non-student families, resulting from the income of students' working mothers

Fig. 10

Social Benefit Categories



imputed in that they do not appear in the accounting statements of public or private parties as items specifically related to public education. For the sake of completeness, non-market benefits are included. It is hoped that this figure might be suggestive for benefit spillover analysis of a variety of public services.

In order to be consistent in identifying and measuring benefit elements associated with an education expenditure and in tracing and measuring their intercommunity spillover, let us restate some of our key assumptions. As in the cost spillover analysis, we assume that the federal government, through appropriate monetary and fiscal means, maintains employment at a relatively high stable level. Payments for resources used in the education process reflect the value of alternative employment opportunities. Benefits and costs of such supplementary school services as lunches, health services, summer schools, and adult education are excluded from the analysis.

Again, to achieve consistency with the procedure for estimating public education cost, the present value of the stream of expected future benefits is valued as of the end of the initial decision period. The migration process is assumed to begin at the end of this period.

What are the leading sources of benefit spillover? Although cost spillovers result almost exclusively because of the fiscal interdependence of a school district with other government units, benefit spillovers can result from both migration and fiscal interdependence.

For those benefit elements which are spilled over, beneficiaries must be identified in terms of the geographic jurisdiction where they resided at the time the expenditure decision was made. As in the cost spillover analysis, here also we will consider six geographic areas.

In summary, there are various forms by which a community might benefit financially from education. Since education appears to raise both productivity and earnings, education will tend to enhance aggregate community income as seen at the time the expenditure decision is made. In addition to the direct long-run income effects, direct short-run effects result in incremental income of mothers who are freed to seek outside employment while schools provide custodial childcare. The geographic locus of these benefits will be identical with that of the direct income benefits to students.

Next are the indirect long-run effects, some financial and others most difficult to quantify. One such indirect effect develops when the income of educated people rises and other community residents can expect to benefit from educationto the extent that educated people pay higher taxes. If the level of income and education does not affect consumption of public services, but does affect tax payments, raising the income of some people will reduce the tax burden and/or increase services for others. Fiscal interdependence and migration can affect the magnitude of this benefit for a community. Four other indirect benefits are considered separately in Chapter XII. One is the indirect income effects resulting from productivity and income increases of individuals who benefit from working side by side with educated persons. A second indirect benefit involves reduced public service costs, while the third and fourth are related to the student's future family and the society as a whole.

Intercommunity Benefit Spillover Mechanisms

What are the mechanisms that generate intercommunity benefit spillovers? How do these mechanisms work and what are some of their implications for our analysis? These questions were alluded to earlier and will be examined in detail at this point.

The two major benefit spillover mechanisms are fiscal interdependence and population migration. An orderly discussion of these mechanisms will be facilitated by a two-step analysis: first, benefit spillovers will be examined when the population is stationary—a situation where only fiscal interdependence is at work; second, this assumption is relaxed, allowing for population migration, growth and decline—a situation where both forces are at work.

Benefit Spillover Analysis with a Stationary Population

Intercommunity benefit spillovers generated by fiscal interdependence alone can be viewed within the simplified framework of an economy with a stationary population. We shall assume that there is no population migration between political jurisdictions of the country. Laborers and consumers can commute on a daily basis between areas; non-human productive factors as well as final products may move freely. To abstract from issues of growth and decline, a fixed total population in each area will also be assumed. Fiscal interdependence will be the sole mechanism of spillovers.

In following chapters the incremental income realized by students and the working mothers of students will be estimated. Local, state, and federal governments exercise claims upon these increments either directly through income taxation or indirectly through taxes upon purchases or property. We shall assume that the demand for government services is independent of income. Therefore, tax payments by the recipients of increased income from the provision of education permit either a reduction in tax rates or a rise in the service level. Here we will consider reductions in average tax rates, holding government expenditure and service levels constant. In the empirical portion of the analysis, this study also assumes rising government service demands and expenditures. However, because of the education-induced tax revenue increase, governments are able to finance the added expenditure without raising tax rates—a relative, rather than absolute, tax rate reduction. For finite marginal tax revenue increments, either assumption gives approximately the same empirical result. Estimated existing average tax burden as a proportion of income may therefore be taken as a suitable measure of the proportion of total incremental income from the provision of education that is apportioned to government in the form of final tax burden.

Fig. 11 illustrates the spatial spillover of these increased tax payments which are ultimately realized as tax reduction benefits. Two areas are identified: the local school district, area 1, and all other districts, area 2. Increased tax payments result from education provided in each area (line 1). In the absence of migration between areas 1 and 2, the initial beneficiary of education, i.e., the student or his working mother, resides in the same district in which the education was provided (line 2). The initial beneficiary of area 1, however, may bear the burden of taxes raised in both areas 1 and 2 (line 3). He may bear the burden of area 1 taxes as a result of direct participation in the economy of area 1, for example, as a property owner in area 1. He may also bear the burden of taxes included in the selling price of area 2's products. The incidence of the tax reduction benefit is realized by those persons living in areas 1 and 2 who enjoy lower taxes or lower product prices (line 4).

Theoretical and methodological considerations involved in determining the magnitude of the tax reduction benefits are examined in the following chapters. Here we will present the general methodology for distributing these benefits spatially.

Fig. 11

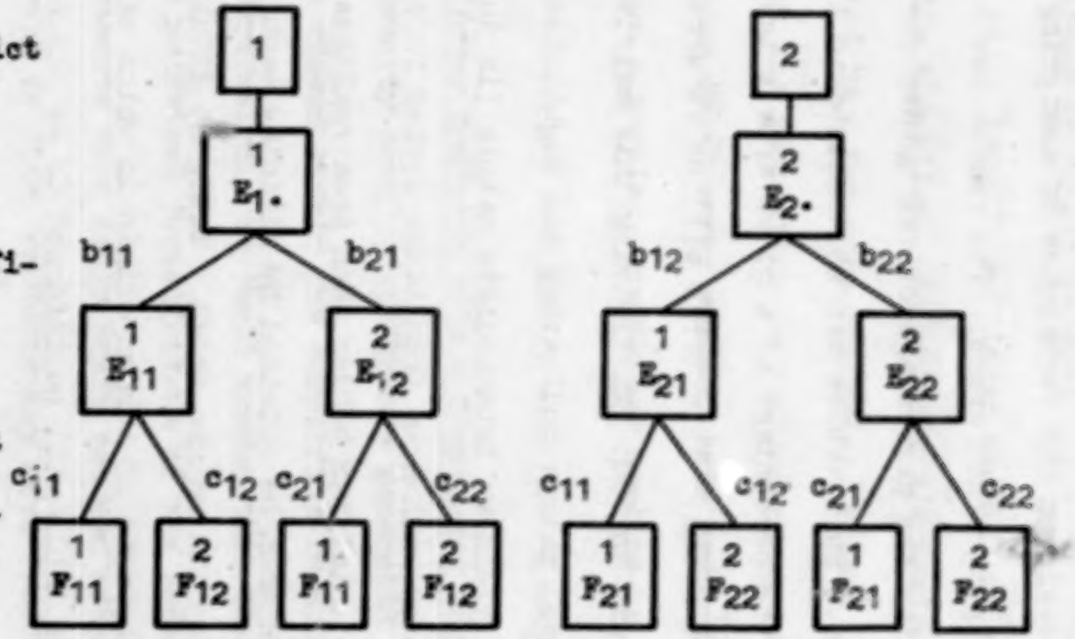
Spatial Spillover of Tax Reduction Benefits of Stationary Population

1. Benefits of education provided in district

2. Initial beneficiary lives in district

3. Tax spillin models (Table 65) show beneficiary bears tax burdens from levies of district (same as Table 66)

4. Tax spillout models (Table 64) show that the ultimate beneficiaries of the tax reduction benefits are residents of district (same as Table 66)



Note: b, c, E, and F indicate the specific relation between this figure and Tables 64 through 67

Chapters III through V developed the techniques of assigning tax burdens to residents of various geographic areas. The reader has become familiar with tables presenting the percentage of tax burden for individual taxes borne by each area. Such tables may be combined in the form of Table 64 which indicates the percentage of a given area's taxes borne by that area and by all other areas. This table will be referred to as the spillout matrix. Each row sums to 100. Multiplying this matrix of spillover coefficients by a diagonal matrix indicating the magnitudes of taxes collected in each area, will yield an intermediate matrix (in dollar amounts) of the burden borne by each area from taxes levied in each area. The percentage of the total tax burden each area realizes from taxes levied in all areas can then be obtained by dividing each cell entry in this intermediate matrix by its column total. Table 65 illustrates the percentage matrix of burden by area of burden origin in which each column totals to 100 per cent. This table will be referred to as the spillin matrix.

Tables 64 and 65 are important connective links in Fig. 10. Table 64 relates lines 2 and 3 of Fig. 10; it indicates the portion of the initial beneficiary's burden arising from taxes levied by each area. Applying the matrix in Table 65 to line 2 of Fig. 11 (the latter represented as a diagonal matrix), yields the information presented in Table 66, a distribution of the tax burden of initial beneficiaries by the areas levying the taxes. Table 66 is equivalent to line 3 of Fig. 10. Lines 3 and 4 of Fig. 10 are related by Table 64, i.e., the tax reduction benefit is allocated to the various areas in proportion to their respective roles in bearing the burden of taxes raised by each of the taxing jurisdictions. The final spatial incidence of the tax reduction benefit (line 4 of Fig. 10) is thus determined

Table 64

Tax Spillout Matrix: Percentage Distribution of Generated Tax Burden By Area of Realization

		Area Realizing Tax Burden		
Area Generating Tax Burden	area	1	2	Total
	1	c_{11}	c_{12}	100
	2	c_{21}	c_{22}	100

C_{ij} = The percentage of total burden generated by Area i that is realized by residents of Area j.

Table 65

Tax Spillin Matrix: Percentage of Distribution Of Realized Tax Burden By Area of Burden Origin

		Area Realizing Tax Burden	
	area	1	2
Area Generating Tax Burden	1	b_{11}	b_{12}
	2	b_{21}	b_{22}
	Total	100	100

b_{ij} = The percentage of total burden borne by residents of Area j resulting from taxes levied in area i.

Table 66

Tax Burden Realized by Initial Beneficiary, Classified By Area of Burden Origin (in dollars)

	Area of Burden Origin		
Initial Beneficiary's Area of Residence	1	2	Total
1	E_{11}	E_{12}	$E_{1.}$
2	E_{21}	E_{22}	$E_{2.}$

E_{ij} = The dollar amount of tax burden benefit derived from education in Area i through taxation by Area j.

by the pattern of tax burden realized by the initial beneficiary and the pattern of tax spillovers of each of the jurisdictions imposing taxes. This final spatial allocation, Table 67, is obtained by multiplying the matrices in Tables 65 and 66.

Benefit Spillover Analysis with a Changing Population

There is the possibility of spatial benefit spillover not only from the forces of fiscal interdependence but also from the processes of population change—migration and growth. This is particularly true since a major portion of education's benefits are long-run in nature. Students may move to other areas in the future. In Fig. 12 those educated in district 1 (line 1) at time (t_0) may reside in any subsequent period (t_n) in either area 1 or in area 2 (line 2). It is as residents of area 1 or 2 that students contribute part of their incremental earnings to the support of government activities. Lines 2, 3 and 4 of Fig. 12 then correspond to the same lines in Fig. 11 as discussed above. But because of migration and natural population change (birth and death), the residents of areas 1 and 2 at time (t_n) (line 4), i.e., the final beneficiaries of the tax reduction benefit, may have moved away from their residence area of time (t_0). The method of this study is to identify the financial interests of beneficiaries in terms of the year in which the education is provided. This requires not only that the benefits be represented in present value dollar terms but also that benefits be associated with the areas in which the beneficiaries or their families resided at the time the education was provided. Therefore, the tax reduction benefits of line 4 which are ordered by residency at time (t_n) are traced back to time (t_0) through the migration and population change information which related lines 1 and 2.

In line 5 of Fig. 12, the tax reduction benefits to residents of area

Table 67

Area of Tax Reduction Benefit Origin (Initial Beneficiary's Area Of Residence) by Area Realizing Benefit (in dollars)

		Area Realizing Benefit		
		1	2	Total
Area Generating Benefit	1	F_{11}	F_{12}	$F_{1\cdot} = E_{1\cdot}$
	2	F_{21}	F_{22}	$F_{2\cdot} = E_{2\cdot}$

where,

$$F_{11} = c_{11} E_{11} + c_{21} E_{12}$$

$$F_{12} = c_{12} E_{11} + c_{22} E_{12}$$

$$F_{21} = c_{11} E_{21} + c_{21} E_{22}$$

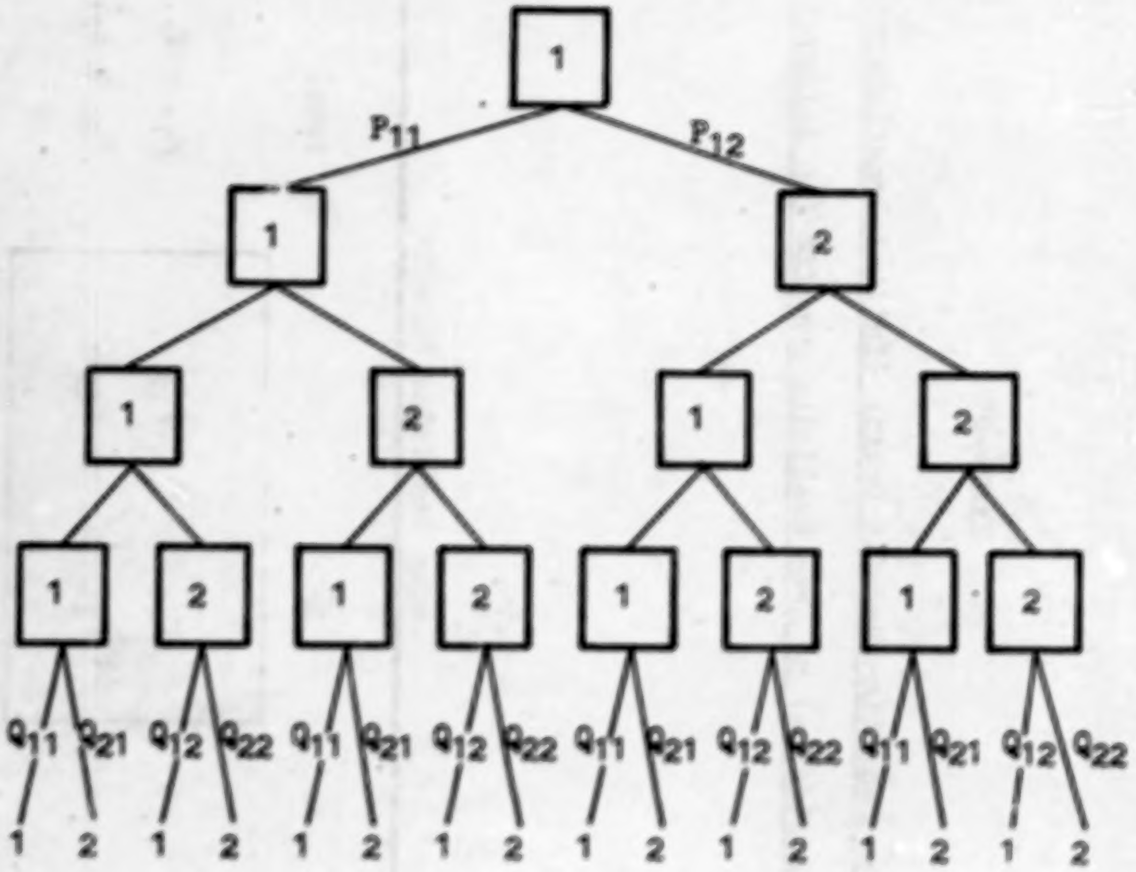
$$F_{22} = c_{12} E_{21} + c_{22} E_{22}$$

F_{ij} = The dollar amount of tax burden benefit generated by Area i realized by residents of Area j.

Fig. 12

Spatial Spillover of Tax Reduction Benefits of a Changing Population

1. Students (initial beneficiary) educated in district
2. Population projection models (Table 69) show future residence of students in district
3. Tax spillin models (Table 64) show students bear tax burdens from levies of district
4. Tax spillout models (Table 65) show the benefits are realized by residents of district
5. Projections of residence in past periods (Table 70) show that in the year the student was educated, these beneficiaries resided in district



Note: P and Q indicate the specific relation between this chart and Tables 69 and 70.

Fig. 12, Part ii

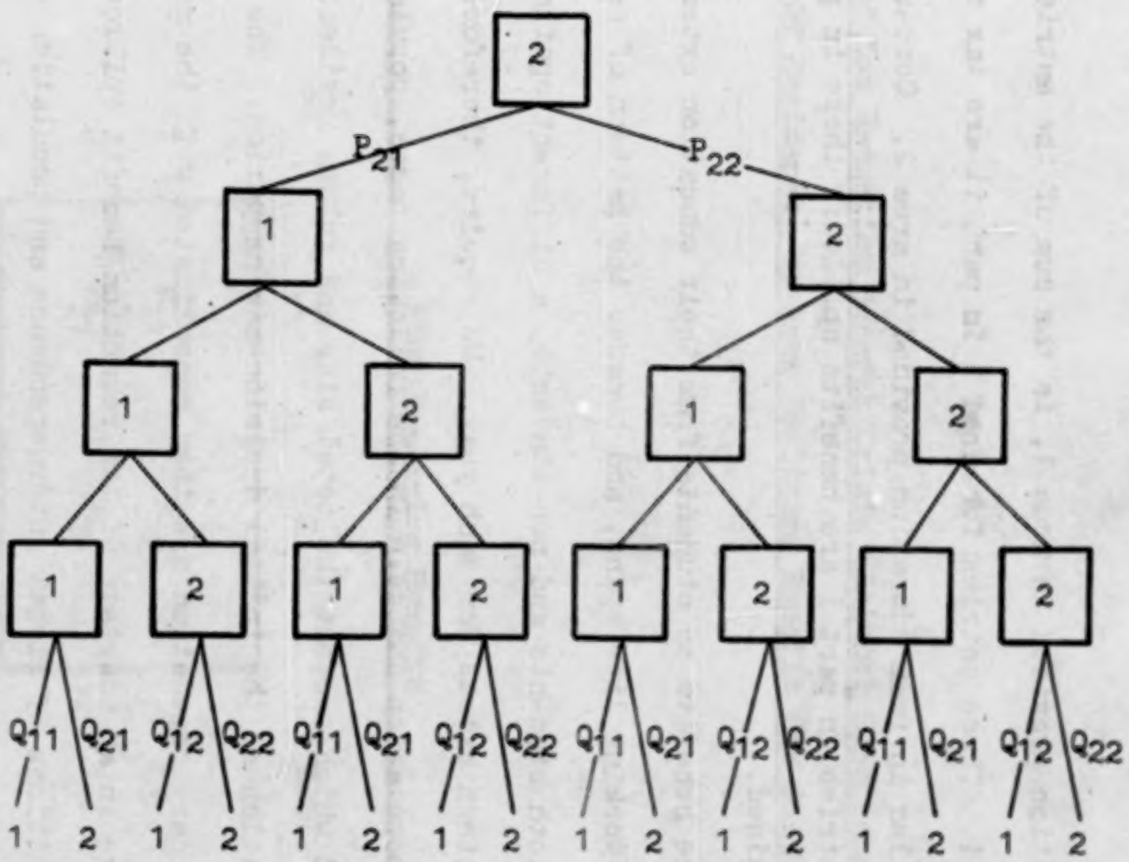
1. Students (initial beneficiary) educated in district

2. Population projection models (Table 69) show future residence of students in district

3. Tax spillin models (Table 64) show students bear tax burdens from levies of district

4. Tax spillout models (Table 65) show the benefits are realized by residents of district

5. Projections of residence in past periods (Table 70) show that in the year the student was educated, these beneficiaries resided in district



1, from education provided in area 1, is the sum of the entries for that area in part i. Those entries for area 1 in part ii are tax reduction benefits spilled in from education provided in area 2. Conversely, for area 2 the entries in part i are benefits spilled: those in part ii are benefits retained.

Since the benefits to students from their education extend throughout their future working life spans, and because the pattern of residence changes for both students and non-students, a different spatial benefit spillover pattern exists for each year. We require, therefore, a dynamic analysis of population change. In the following pages, population models are developed which project the total size and future residence for each area's population at the initial decision-making period. The tax models of the stationary population are then consolidated with the models of population change in an anaylsis of tax reduction benefit spillover under the combined conditions of fiscal interdependence and population change. This final model will be implemented for the case study.

Population Analysis

The population of an area may be defined as the aggregate number of legal residents of a finite geographic-political community during an initial time period—the decision-making period. Within this framework, population movements may be defined to include any permanent entry or exit of a person from an area. Entry or exit, according to this definition, is the result not only of birth or death, but also of in- and out-migration, excluding transitory movements such as commutation and tourism.

Residents of an area may give birth, die, or out-migrate during the period; residents of other communities may in-migrate. Projection of population changes thus requires a dynamic analysis of population movements and growth. This analysis rests on the postulate of certain stable difference equations.[1] We may, for instance, postulate a stable "survival" function showing how many residents of a community in an initial period (t_0) remain residents ("survive") to each subsequent period ($t_1,\ldots,t_n$). For example, of 100 initial period residents of a community, 90 may "survive" for one year, 85 for two years, 81 for three years, and so on down to the last "survivor." A series of difference equations yields the survival function:

$$a_1 = k_1a_0, \quad a_2 = k_2a_0,\ldots,a_n = k_na_0$$

where (a_n) is the number of initial period residents of a community that "survive" in the community to year (n) out of the initial total number of persons (a_0). Thus, the number of initial residents (a_0), who do not survive—i.e., die or out-migrate—from one year (t_r) to the next (t_{r+1}), is equal to $(k_r - k_{r+1})a_0$. In the simplest form of the function, $k_1, k_2,\ldots, k_n$ are constants.

For purposes of local decision-making, it is not sufficient to postulate a stable survival function showing how many initial residents remain in the community to each subsequent period; it is necessary to show in which of the other areas they are, in each subsequent period. Moreover, since it is also necessary to project absolute change in total population size, the number and rate of births and deaths in all areas must be projected for each period. If each area's rate and geographic pattern of population migration and growth remains constant for all subsequent periods, the difference equations of our population models can be readily presented in matrix form.

Three basic migration matrices are derived from the assumed population stability equations. Table 68 is an absoulte population matrix; it identifies the pattern of entry and exit between the communities of the analysis within a single time period. Each entry (M_{ij}) shows the number of residents in area (i) at time (t_0) residing in area (j) at time (t_1). This matrix is basic; it both summarizes the assumed population stability conditions and provides the basic input data from which other matrices are generated.

Table 68 describes population migration between area 1 and area 2, all other areas; area 3 represents natural change, i.e., birth and death. This table relates lines 1 and 2 in Fig. 12. The sum of the first row entries ($M_{1.}$) is the total population of area 1 in the initial period. (M_{11}) is the number of residents in area 1 at time (t_0) who are still living in area 1 at time (t_1) (the non-migrants). (M_{12}) is the number of persons living in area 1 at (t_0) who live in area 2 at time (t_1) (the out-migrants), and (M_{13}) is the number of initial period residents of area 1 who have died in the period.

The column entries of Table 68 show where the population of an area at (t_1) resided at time (t_0). They relate lines 4 and 5 of Fig. 12. Thus, (M_{11}) is the number of persons living in area 1 at time (t_1) who also lived in that area at time (t_0) (the non-migrants); (M_{21}) is the number living in area 1 at time (t_1) who resided in area 2 at time (t_0) (the in-migrants); (M_{31}) is the number living in area 1 at time (t_1) who were born during the period either to in-migrants or non-migrants. ($M_{.1}$) is the number of residents in area 1 at (t_1).

There is migration between areas 1 and 2, and movement from areas 1, 2 and 3 (birth) to area 3 (death). (M_{33}) is equal to zero unless fetal deaths and stillborn births are counted. The sum of all rows, the total initial year population, is equal to that of all columns, the total projected year (t_1) population, only in a special case—when births equal

Table 68

Population Transition between Areas From Time (t_0) and (t_1), in Absolute Numbers

Population by Area at (t_1)

Population by Area at (t_0)	1	2	3 (death)	Total
1	M_{11}	M_{12}	M_{13}	$M_{1\cdot}$
2	M_{21}	M_{22}	M_{23}	$M_{2\cdot}$
3 (birth)	M_{31}	M_{32}	M_{33}	$M_{3\cdot}$
Total	$M_{\cdot 1}$	$M_{\cdot 2}$	$M_{\cdot 3}$	

M_{ij} = The number of persons at Area (j) at time (t_1) who had been at Area (i) at time (t_0).

$M_{33} = 0$

deaths. If the total number of births in all areas (row 3) exceeds the total number of deaths in all areas (column 3), the absolute size of the universe population will grow, although that of any one area might decline due to either higher-than-average rates of exit, or lower-than-average rates of entry.

The absolute population migration matrix (Table 68) can be translated into two categories of population migration rate (probability) matrices, Tables 69 and 70. Table 69 projects the probable future residence for each area's initial population. Each (P_{ij}) of Table 69 is the probability of a resident of area (i) at time (t_0) residing in area (j) at time (t_1). Thus (P_{21}) is the probability of a resident of area 2 at time (t_0) living in area 1 at time (t_1); (P_{22}) is the probability of area 2 residents at time (t_0) still living in area 2 at time (t_1); while (P_{23}) is the probability of the area 2 residents at time (t_0) having died by time (t_1). Children born during the period may be assumed to have the same probability of migration as their parents, so that there are no entries to row 3 of Table 69. Each transition probability of Table 69 is the identical cell entry of Table 68 divided by its row total, so that the sum of each row is 1.00. The probabilities of column 3 are not of interest here and are not computed.

Successive movement forward in time is derived from Table 69. For example, the probability of the initial population of an area residing in any given area at time (t_2) is given by Table 71. The probability of a resident of area 1 at time (t_0) residing in that area at time (t_2) is not only the probability of his living in area 1 at time (t_1) and remaining there another year, but also the probability of his living in area 2 at time (t_1) and then migrating back to area 1. In similar fashion, a rate matrix can be generated for each projected period.

Table 69

Probability of Future Population Transition between Areas

	Population by Area (t_1)			
Population by Area (t_0)	1	2	3 (death)	Total
1	P_{11}	P_{12}	P_{13}	1.00
2	P_{21}	P_{22}	P_{23}	1.00
3 (birth)	0	0	0	0

P_{ij} = Probability of a person at Area (i) at time (t_0) being at Area (j) at time (t_1).

$$P_{ij} = \frac{M_{ij}}{M_{i.}}$$

Table 70

Probability of Past Population Transition between Areas

Population by Area (t_0)	Population by Area (t_1)		
	1	2	3 (Death)
1	Q_{11}	Q_{12}	0
2	Q_{21}	Q_{22}	0
3 (Birth)	Q_{31}	Q_{32}	0
Total	1.00	1.00	0

Q_{ij} = Probability of a person at Area (j) at time (t_1) having been at Area (i) at time (t_0).

$$Q_{ij} = \frac{M_{ij}}{M_{.j}}$$

Table 71

Probability of Future Population Transition between Areas from Time (t_0) to Time (t_2)

	Population by Area (t_2)			
Population by Area (t_0)	1	2	3(death)	Total
1	P'_{11}	P'_{12}	P'_{13}	1.00
2	P'_{21}	P'_{22}	P'_{23}	1.00
3 (birth)	0	0	0	0

where P_{ij} = Probability of a person at Area (i) at time (t_0) being at Area (j) at time (t_2)

and

$$\begin{aligned}
P'_{11} &= P_{11} \cdot P_{11} + P_{12} \cdot P_{21} \\
P'_{12} &= P_{11} \cdot P_{12} + P_{12} \cdot P_{22} \\
P'_{13} &= P_{11} \cdot P_{13} + P_{12} \cdot P_{23} \\
P'_{21} &= P_{21} \cdot P_{11} + P_{22} \cdot P_{21} \\
P'_{22} &= P_{21} \cdot P_{12} + P_{22} \cdot P_{22} \\
P'_{23} &= P_{21} \cdot P_{13} + P_{22} \cdot P_{23}
\end{aligned}$$

The basic population difference equations represented by Table 70 assume, in effect, that each area's initial period rate and pattern of transition will remain unchanged for all projected time periods. On this assumption it is possible to project the size and composition of any area's population in period (t_n) with respect to the residence of that population at time (t_0), while taking account of all interarea migration in the intervening periods (Table 70).

The migration and natural change of an area's population are determined by economic and social forces. They are closely tied to cultural values, resource endowments, industrial development, income level, as well as the educational system and public services.

Intracommunity demographic differences are likely to arise from differences in age, sex, race, level of education, and income. In principle, it is possible to stratify and cross-classify the population of each area according to these characteristics. A projected composition of each area's population in period (t_n) with respect to period (t_0) could be made, assuming transition stability within each demographic cohort group. Such detailed classifications would increase the accuracy of the population projections. They would permit relaxation of the limiting assumption of a constant average rate and pattern of community transition by introducing changes in the demographic composition or mix of an area as a feedback upon the transition process. While such improvements in the dynamics of population change are of demographic interest, they are beyond the scope of this study.

The preceding pages have outlined the incorporation of migration and fiscal interdependence into the spillover model. The Appendix presents the details of the procedure and the data sources used for the empirical implementation of the model. In the following two chapters the mechanisms discussed here will be employed, without further elaboration, in estimating the spillovers of education benefits; we believe that they are applicable to the investigation of other public services as well.

Chapter X

STUDENTS' INCREMENTAL EARNINGS

Of all of the benefits of education, one of the most important is the gain in productivity and earnings of the educated.[1] Public education increases the knowledge and skills of students and, therefore, tends to increase their potential earnings. While there is general agreement that the level of educational attainment has a positive effect on income, relatively little is known about the magnitude of this relationship when differences due to other factors are taken into account.[2] It is to this problem that we will address ourselves in this chapter.

In order to present an analytical and empirical examination of the productivity of education capital measured in terms of students' incremental earnings, the following procedure will be used. First, we will advance a hypothesis about those factors, including years of schooling, affecting a person's income and test it by submitting survey data to a multivariate analysis, thus obtaining estimates of the net relation between education and future income. Next, the findings will be applied to estimate incremental lifetime earnings resulting from education and their present value, so that comparisons can be made between these benefits and corresponding annual education costs. Finally, spillover estimates of the incremental income of Clayton's students will be presented.

Concepts and Hypothesis

How can we estimate the amount of income associated with a given increase in education, when other factors are taken into account? One method, which makes a somewhat arbitrary allowance for factors other than years of schooling, has been employed by Burton A. Weisbrod.[3] Using Census income data classified by age, race, sex, region of country, and level of education, he computed the "average income" of each classification after adjusting for unemployment. He then subtracted the average income of persons in each classification with no education to obtain an average income increment resulting from additional education. The present value of lifetime income accompanying an elementary and high school education, or portions thereof, was computed by summing the expected future incremental income stream up to age 75, adjusting for the probability at each age of surviving at least one more year. This stream of income was then discounted at alternative rates of interst. In line with the Denison formula,[4] the present value differentials thus derived were then multiplied by a factor of 0.6 to "account in a rough-and-ready way for non-education factors influencing the Census findings."[5]

Several possible alternative approaches to the problem of studying the relationship between income and education suggest themselves. Under ideal circumstances, one would conduct a controlled experiment by selecting individuals identical or nearly identical in all relevant respects, except for the public education they receive. Differences in monetary earnings between individuals within the group could then be attributed to public education. The main defect in such a procedure is the inability to identify all the relevant variables, or to locate data even if those variables could be identified.

Another approach, for which some of the above difficulties obtain, would be to design a longitudinal study, using a sample of children whose relevant characteristics are surveyed and whose earnings are recorded during much of their productive lives. These data would then be subjected to a multivariate analysis which would produce estimates of the net earnings effect of education.

We have chosen a third approach, examining the relationship between income and education with the aid of a multivariate analysis of data collected in a sample survey made in the St. Louis City-County area in 1957. These data are, in turn, assumed to reflect the income-education relationship of Clayton, Missouri, and are used for students in the Clayton School District regardless of future residence. In this study the incremental value of additional schooling is assumed equal in all labor markets, and it is also assumed that present differentials will continue to be maintained. Regression coefficients representing the net effect of education on income are estimated and then discounted to the year of the expenditure decisions, after adjusting for the probability of death between the time an individual graduates from high school and reaches retirement age.

What follows is an enumeration of variables which logically could be responsible for differential earnings.

Income—X_1

In the abstract, the net effect of additional years of education is best measured in terms of differential earnings. However, such data are uncommon compared to total income figures, which include also interest, rent, dividends, and other recepts. This study is based upon 1956 household-head income before taxes.[6]

Race—X_2

Equally productive individuals may be paid different wages as a result of an employer's or his customers' "taste for discrimination."[7] Society may also affect the earning capacity of self-employed individuals of a minority race by offering diminished or restricted opportunities.

Sex—X_3

Discrimination by sex can be no less severe than by race. However, wage differences between male and female employees may reflect, in part, the employer's evaluation of loss and inconvenience caused by female employees' leaving to marry and raise children. In addition, other social characteristics of female household heads tend to increase the association between this group and low incomes.

Years of Schooling—X_4

This is the variable whose net effect on income we have chosen to study, while controlling the effect of other variables. Aside from differences in education quality, a given number of years of formal education may not be strictly comparable between communities because of possible differences in order composition of the curriculum (i.e., subject matter taught in the 4th grade in one community may be taught in the 5th grade in a second community). Comparability tends to increase, however, with the number of years of schooling taken into consideration.

Education Quality in Terms of Expenditures—X_5

Since our main task is the measurement of the net effect of years of schooling on income, the factor of education quality must be held constant. Ways of measuring such quality and the difficulties involved have been discussed elsewhere by one of the authors.[8] Measurement should include, among other considerations, length of school year, teacher qualifications, class size, quality of school administration, nature of teaching programs, and grouping of students. However, in the absence of this information, deflated per pupil expenditures have been used to reflect education quality, while noting that expenditure per pupil in average daily attendance is but a rough approximation of the quality of education provided by a local school district in a given year.

Occupation—X_6

In a recent study it was pointed out that an individual's occupation influences his earnings even after adjustments are made for age and education of various occupational groups. It found that ". . . Professionals, managers and self-employed businessmen earn more than one would expect after allowing for their educational advantages."[9] Thus, income variations between individuals with dissimilar educational attainment may reflect one's occupation no less than one's education, and occupation may therefore be a supplementary measure of the abilities and opportunities of individuals.

Self-Employment and Supervisory Status—X_7

Classification by occupation of heads of household may not reflect certain income differences associated with one's particular job. Of special interest is the fact of whether or not an individual is self-employed and has major supervisory responsibilities.

Informal Education as Reflected by Occupation of Father—X_8

Father's occupation can, to some extent, reflect informal education or other educational advantages accruing to a student in his home environment.

It is suggested, for example, that in a household where the father is a member of the professions, children are likely to receive informal education through the father's professional and cultural interests and also to acquire positive attitudes to formal study.

Experience in Terms of Age—X_9

In a fully employed economy, workers can acquire further skills and increase their productivity as they become older and more experienced. Conversely, when unemployment occurs, some persons age without realizing a corresponding increase in work experience and some are forced to start fresh on new jobs and forego the use of experience previously gained. However, complications arise in analyzing this variable since those who remain in school do not obtain on-the-job experience as do those of similar age in the labor force. Moreover, length of the learning period differs in proportion to the nature of the job.

We may note that age is probably an imperfect measure of experience in periods of high unemployment and also during those times when individuals are forced to change occupations because of dynamic changes in employment opportunities; also, age is a poor measure of experience for women, since many initially join the labor force when childcare demands at home lessen. Age may be a good approximate measure of experience for men only within broad occupational classifications.

Migration from the Deep South—X_{10}

Migrants to a metropolitan area such as St. Louis, especially those from the Deep South, are likely to have less firsthand knowledge of the availability of jobs than comparable non-migrants. In such cases migrants' incomes will be lower than those of long-time urban workers. On the other hand, the person who leaves the Deep South or nearby farm areas may realize higher earnings because of stronger motivations to gain from urban opportunities.[10]

Size of Birth Place—X_{11}

Education quality, as measured by expenditure per pupil in average daily attendance (X_5), can be adjusted for possible differences in the efficiency of expenditure resulting from economies of scale. In general, we would assume that communities with larger populations, especially in past periods, were likely to be more efficient in the sense that they were either better able to provide the same education quality at lower per student cost, or higher quality at the same unit costs of smaller sized areas.

Native Ability—X_{12}

Native intelligence should facilitate the learning process and improve earning potential. A recent study found that men who either scored higher on intelligence tests or ranked higher in their high school graduating class, but reached the same level of formal post-high school education, consistently earned more than men who either scored or ranked lower in high school.

Motivation—X_{13}

Although motivation is difficult to measure, we assume that it is defined by a student's desire to learn, which in turn affects his level of educational achievement. It is somewhat less clear whether the highly motivated student will also enjoy higher lifetime earnings, since such an individual may tend to seek employment where the satisfaction of his intellectual curiosity is greater than the rewards of income.

Physical Ability—X_{14}

Physical stamina and health can affect productivity and income, although measurement in these areas is difficult to obtain.

In summary, the general hypothesis may be stated as follows:

$$X_1 = f(X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12}, X_{13}, X_{14}) \quad (1)$$

where all notations are the same as defined above. However, the absence of reliable data has forced us to drop the last three variables. The loss of the ability and motivation variables are probably the most serious, and their absence presumably overstates the income benefits of education.

Test of Hypothesis

Description of Statistical Technique

In order to isolate the effect of years of schooling on income, a multivariate analysis was made. This method can be viewed as an extension of multiple correlation analysis except that, since the descriptive variables do not have numerical values, they are placed within various subclasses where possible.[12] Many of the independent variables are basically qualitative in nature and, to the extent that a numerical scale for these variables can be prepared, they appear to have a nonlinear relation to income.

In the multivariate analysis, each explanatory classification or variable is converted into a set of "dummy variables," which are valued as "one" if an individual belongs to a particular subclass and "zero" if he does not. For example, instead of having a single regression coefficient for age, we have a set (one for each age group) so constrained that their weighted sum is zero. In order to solve the normal equations used to estimate the regression coefficients, a homogeneous form involving moments around zero, rather than moments around means, is used. Thus, one of the regression coefficients of each variable with more than two "dummy variables" is arbitrarily set to equal zero, and the sum of all dummy variable coefficients of a given variable is constrained to be equal to zero.[13] As previously noted, an advantage of using dummy variables is that no restrictive assumptions are made about the linearity of the effect. The resulting regression equation has the following characteristic: the summed squared errors of the predicted dependent variable are smaller than for any other equation using the same factors and the same additive model.

Description of Data and Variables

Except for the education expenditure data, all data are taken from a sample survey made in the St. Louis City-County area in 1957 by the Metropolitan St. Louis Survey. This survey drew a probability sample of over 2,000 individuals and each respondent was interviewed in person.[14] In the present study a subsample of the total probability sample was taken, numbering 238 persons, which included only those respondents who were heads of households, had less than a college education, were educated in the United States, were employed, and were 21 years of age or older. Since the original sample included one per cent of the dwelling units in St. Louis but by only one-fourth of one per cent of all dwelling units in St. Louis City, only every fourth St. Louis County household of the original sample was included in the subsample.

The sample survey provided data for ten of eleven variables. Expenditure data (X_5) had to be developed separately. The procedure used to estimate average education cost of the respondents is as follows: the geographic area in which the respondent's public education was provided was determined by locating his area of residence while in the 6th grade, assumed to be a typical year of education. Historical expenditure data were available for approximately two-thirds of the respondents. For the remaining one-third, average state expenditure data per student in average daily attendance was computed and then adjusted for average differences in state expenditures per student in urban and rural areas, and for differences in expenditures for Negroes and whites in southern states. These historical expenditures were then converted into 1956 dollars by using an index of educational costs. The historical education cost index that was constructed is a composite of average annual salaries of the total United States instructional staff, weighted by the proportion of salaries to total current United States public education expenditure, plus the Bureau of Labor Statistics' Wholesale Price Index of all commodities other than farm and food weighted by the proportion that nonsalaries comprised of current expenditure.[15]

The multivariate analysis involves eleven variables: the dependent variable — personal income — and ten independent variables. In addition to dichotomous dummy variables of race, sex, self-employment, and migration from the Deep South, there were the additional dummy variables of 4 years-of-schooling levels, 7 expenditure levels, 6 types of occupation of head of household, 7 types of occupation of father, 6 age groups, and 6 sizes of birth place. Thus we total one dependent and 30 independent variables. The equations are as follows:

$$X_1 = a + bX_2 + cX_3 + dX_4 + eX_5 + fX_6 + gX_7 + hX_8 + iX_9 + jX_{10} + kX_{11} \quad (2)$$

where

$$X_4 = d_1X_{41} + d_2X_{42} + d_3X_{43} + d_4X_{44} \tag{3}$$

$$X_5 = e_1X_{51} + e_2X_{52} + e_3X_{53} + e_4X_{54} + e_5X_{55} + e_6X_{56} + e_7X_{57} \tag{4}$$

$$X_6 = f_1X_{61} + f_2X_{62} + f_3 X_{63} + f_4 X_{64} + f_5X_{65} + f_6X_{66} \tag{5}$$

$$X_8 = h_1X_{81} + h_2X_{82} + h_3X_{83} + h_4X_{84} + h_5X_{85} + h_6X_{86} + h_7X_{87} \tag{6}$$

$$X_9 = i_1X_{91} + i_2X_{92} + i_3X_{93} + i_4X_{94} + i_5X_{95} + i_6X_{96} \tag{7}$$

$$X_{11} = k_1X_{11.1} + k_2X_{11.2} + k_3X_{11.3} + k_4X_{11.4} + k_5X_{11.5} + k_6X_{11.6} \tag{8}$$

and

X_1 = 1956 income of respondent head of household before taxes

X_2 = Race

  X_{21} = White

  X_{22} = Non-white (Negro)

X_3 = Sex

  X_{31} = Male

  X_{32} = Female

X_4 = Years of schooling completed

  X_{41} = Less than 8 years

  X_{42} = 8 years completed

  X_{43} = Less than 4 years high school

  X_{44} = 4 years high school completed

X_5 = Expenditure (in constant dollars) per pupil in average daily attendance

  X_{51} = \$0-49

X_{52} = \$50-99

X_{53} = 100-149

X_{54} = 150-199

X_{55} = 200-249

X_{56} = 250-299

X_{57} = 300-349+

X_6 = Occupation of head of household

X_{61} = **Professional, managers, technical, and officials**

X_{62} = **Clerical and sales workers**

X_{63} = **Craftsmen**

X_{64} = **Operatives and kindred workers**

X_{65} = **Service workers, including private household**

X_{66} = **Laborers and farmers**

X_7 = Self-employment and supervisory status

X_{71} = **Self-employed or supervisor**

X_{72} = **Neither self-employed or supervisor**

X_8 = **Occupation of father**

X_{81} = **Professional, managers, technical, and officials**

X_{82} = **Clerical and sales workers**

X_{83} = **Craftsmen**

X_{84} = **Operatives and kindred workers**

X_{85} = **Service workers, including private household**

X_{86} = **Laborers**

X_{87} = **Farmers**

X_9 = **Age**

X_{91} = Less than 25

X_{92} = 25-34

X_{93} = 35-44

X_{94} = 45-54

X_{95} = 55-64

X_{96} = 65 +

X_{10} = Migration from Deep South

$X_{10.1}$ = Grew up in Deep South

$X_{10.2}$ = Grew up in U.S. outside Deep South

X_{11} = Size of birthplace

$X_{11.1}$ = Born on farm

$X_{11.2}$ = Town less than 2500

$X_{11.3}$ = 2500-9,999

$X_{11.4}$ = 10,000-49,000

$X_{11.5}$ = 50,000-49,999

$X_{11.6}$ = 500,000 +

Findings

With the aid of multivariate analysis, it is possible to show that about 40 per cent of the 1956 income variation of heads of households residing in the St. Louis City-County area can be explained in terms of ten variables, with half of the variables each significantly affecting income. The coefficient of multiple determination is statistically significant at an 0.05 probability level. The reader should be careful to note that over half of the variation in income is not explained by the factors included here. Findings are summarized in Table 72 for samples of male heads, white heads, and all heads of households, respectively. Number of years

Table 72

Factors Affecting 1956 Annual Income For All Heads of Households, For Male Head of Households, And For White Heads of Households Residing in St. Louis City-County Area

Variable	Characteristic	All Heads of Household		Male Heads of Household		White Heads of Household	
		Partial Determination	F-Test	Partial Determination	F-Test	Partial Determination	F-Test
X_2	Race	.021	4.40*	.040	7.10**	——	——
X_3	Sex	.078	17.16**	——	——	.128	23.91**
X_4	Years of Schooling	.078	5.72**	.116	7.50**	.122	7.53**
X_5	Education Quality in Terms of Expenditure	.034	1.19	.027	0.80	.038	1.08
X_6	Occupation	.068	2.97**	.083	3.13**	.114	4.20**
X_7	Self-Employment and Supervisory Status	.053	11.39**	.071	13.10**	.073	12.77**
X_8	Informal Education as Reflected by Occupation of Father	.012	0.40	.012	0.35	.018	0.49
X_9	Experience in Terms of Age	.036	1.52	.048	1.72	.044	1.48
X_{10}	Migration from Deep South	0	0.01	0	0.22	0	0.22
X_{11}	Size of Birth Place	.033	1.38	.051	1.84	.046	1.58
		n = 238 R^2 = .3953** R = .6287**		n = 206 R^2 = .3992** R = .6318**		n = 197 R^2 = .4139** R = .6434**	

** significant at probability level of .01
* significant at probability level of .05

of schooling and sex were the most important factors affecting income. (Schooling was the single most important factor when sex was omitted, and the second most important when sex was included). When either male or white heads of families are analyzed, the extent of formal education, on the average, explains about 12 per cent of income variations when the effects of variation of the other nine independent variables on income are held constant. For the entire sample, education accounted for 8 per cent of income variations. Closely following in importance was sex of head of household and, in decreasing order, occupation, self-employment and supervisory status, and race.

An examination of the net regression coefficients reveals a consistent positive effect on income of an additional year of both primary and secondary education. For males in St. Louis in 1956, an additional year of primary-secondary education on the average accounted for a $320 increase in annual income, when the effect of the other factors included in the analysis was held constant. The corresponding figure for white heads of households was $306, and for all heads, $210 (Table 73). In all cases the regression coefficients are statistically significant at a probability level of 0.05. It was also found that each additional year of secondary education had at least twice the positive effect on income as did primary education.[16]

Incremental Lifetime Incomes and Their Present Value

Our next problem is to estimate the stream of future income benefits and their present value through use of the regression results. We assume the normal working life of the high school graduate spans the ages of 18 to 65. To evaluate and directly compare this education benefit with costs, this income stream must be discounted back to the period during which the costs are incurred.[17] In the literature, mainly three different discount rates have been proposed, i.e., 3½, 5, and 10 per cent.[18] All three rates will be used, although major emphasis will be placed on the 5 per cent figure.

Some statements about employment and mortality rates must be made before lifetime income increments can be estimated. We assume full employment. Only respondents who had been employed in the past year (1956) were included in our subsample of the St. Louis Metropolitan Survey, and it was assumed that male students would find employment when they joined the labor force in the future. Respondents who were unemployed for only a part of the year are thus included in the subsample, which means that our income benefit estimates partially adjust for unemployment. Because of the wife's role in family formation and care, the proportion of all women at different ages actively participating in the labor force is substantially smaller than that for males.

Labor force participation rates for women were based upon Bureau of the Census figures, which varied from a high of 60.5 per cent for ages 18-19 to a low of 32.8 per cent for ages 25-29.[19] These figures probably understate expected future labor force participation for two reasons. In part, the low participation rate for females in 1960 was the result of unemployment. Secondly, the existing upward trend in the labor force participation rate for all white females over 14 years of age will probably be maintained for some time in the future.

The present value of a stream of future income benefits is also affected by mortality. At each age, the probability of surviving an additional year changes and with it the length of the income stream declines.

Table 73

Present Value of Future Income of Average Students, Age 12, Resulting From Clayton, Missouri Public Elementary and Secondary Education, at 3½, 5 and 10 Per Cent Discount Rates

1959-1960

	Males only Sample			Combined Sample Males and Females		
	3½%	5%	10%	3½%	5%	10%
1. Annual increment in earnings	$320	$320	$320	$210	$210	$210
2. Value of a unit amount at age 12 due annually from age 18-65 at interest rates of 3½, 5, and 10 per cent, compounded annually*	18.77885	13.48945	4.73885	18.77885	13.48945	4.73885
3. Unadjusted present value of annual earnings increment considered as an annuity (line 1) x (line 2)	$6,009	$4,317	$1,516	$3,944	$2,833	$995

* Stanford Research Institute, Growth Factors-Compound Interest Tables-Negative (Menlo Park, California) n.d. Present Value $1/(1+i)^n$ interest table give the value of unit amount due in n years at rate of interest i, compounded annually, $1/(1+i)^n = v^n$.

Table 73, Part II

	Males only Sample			Combined Sample Males and Females		
	3½%	5%	10%	3½%	5%	10%
4. Present value (line 3) multiplied by .8388, the proportion of white males at age 12 who survive to age 65 (.6776), plus ½ (.3224) the average of the proportion who die before 65**	$5,040	$3,621	$1,272	$3,308	$2,376	$835
5. Total public education capital value of all male students of Clayton School District 1959-1960 (line 4) x (1108 boys enrolled)	$5,584,320	$4,012,068	$1,409,376	$3,665,264	$2,632,608	$925,180

** United States Department of Health, Education and Welfare, Vital Statistics of the United States 1960--Life Tables, Table 2.3

Since a constant annual income increment benefit based on net regression coefficients, was assumed at all ages, the effect of mortality upon the value of the benefit income stream was taken into account by multiplying the present value of the entire income stream by the proportion of persons at age 12 who survive to age 65, plus half of the proportion of those who die by age 65, as shown, step-by-step, in Tables 73 and 74. Since the probability of surviving an additional year declines at an increasing rate at ages greater than 12, the present value of the incremental earnings benefits of education to persons who die before attaining age 65 are certainly somewhat understated by assuming a constant linear probability of survival.

The present value of future income to students resulting from public elementary and secondary education in Clayton, Missouri in 1959-1960 was separately estimated for boys and girls enrolled in Clayton public schools for that school year. With approximately an equal number of students in each grade, and virtually no dropouts in Clayton, we estimated the value of a public education for the average student. We assume that this average student begins the 7th grade at age 12 and completes high school in order to join the labor force at age 18.

Based on the subsample of male heads of household, and using a 5 per cent rate of discount, we find that a year of public education has a present value of $3,621 to the average male in the Clayton public school system. Based on the sample of all heads of household, a lower figure of $2,376 results. Depending on which figure is selected, the total present value of a year's public education provided to all 1,108 male students enrolled in Clayton public schools, using a 5 per cent rate of discount, amounts to $4.0 million or $2.6 million, respectively.

In a similar manner, income estimates for female students can be made.[20] Adjusting for women's labor force participation rates and life expectancy, we find on the basis of a 5 per cent rate of discount that the present value of an additional year of public education for the average female student at age 12 equals $1,147. Thus, assuming a constant annual earnings increment of $210 for both males and females, an additional year of schooling for females is on the average only 48-50 per cent as valuable as for males. The same result was found with alternative 3½ and 10 per cent rates of discount. The total present value to the Clayton public school female students of education provided in school year 1959-1960, at a 5 per cent discount rate, is $1.3 million. These findings are presented separately for male and female students in Tables 73 and 74, respectively.

In summary, using a 5 per cent discount rate and the $210 annual income increment estimate per year of additional education for all heads of household, a conservative estimate of the total present value of education provided in the 1959-1960 school year to male and female Clayton students is $3.9 million. This figure constitutes a 34 per cent rate of return on the $2.9 million cost of providing education in Clayton for the same period. A more liberal estimate would evaluate the annual income increment of male students at $320, which would increase the total present value estimate from $3.9 to $5.3 million—almost an 83 per cent rate of return. These figures are affected by the same biases discussed earlier, plus the fact that the net income-education relationship is based on 1956 data, while the cost data pertain to 1959-1960.

The coefficients of multiple and partial determination of this study can be related to Edward F. Denison's finding: "Of the total earnings differentials, three-fifths are assumed to result from differences in

Table 74

Present Value of Future Income of Average Female Student, Age 12, Resulting from Clayton, Missouri Elementary and Secondary Education, at 3½, 5, and 10 Per Cent Discount Rates, 1959-1960

	3½%	5%	10%
1. Annual increment in earnings (Male and Female combined earnings)	$210	$210	$210
2. Value of unit amount at age 12 due annually from age 18-65 at interest rates of 3½, 5, and 10 per cent, compounded annually.*	18.84540	13.48945	4.73885
3. Unadjusted present value of annual earnings increment considered as an annuity (line 1) x (line 2)	$3958	$2832	$995

* Stanford Research Institute, *op. cit.*

Table 74, Part II

	3½%	5%	10%
4. Present value adjusted for the proportion of women at each age participating in the labor force.**	$1725	$1248	$458
5. Present value (line 4) multiplied by .9194, the proportion of white females age 12 who survive to age 65 (.8263), plus ½ (.1862), the average of the proportion who die before 65***	$1586	$1147	$421
6. Total public education capital value of all female students of Clayton School District 1959-1960 (line 5) x (1,128 girls enrolled)	$1,789,008	$1,293,816	$474,888

** U.S. Bureau of the Census, U.S. Census of Population: 1960, Final Report PC(2) - 5B, Subject Reports-Education Attainment (Washington, D.C.: U.S. GPO, 1963), Table 5.

*** U.S. Department of Health, Education and Welfare, *op. cit.*, Table 2.3

education and associated off-setting differences in work experience, as distinguished from natural ability, energy and other factors."[21] Admittedly Denison refers to the entire United States, while our results relate to a case study. The above-mentioned shortcomings of our data must be kept in mind. Most likely our coefficient of determination has a downward bias, because education quality is not properly reflected. This, however, might be offset by an upward bias resulting from the fact that native ability and motivation were not controlled.

Our data can also be compared to Herman P. Miller's work.[22] He has computed lifetime earnings between ages 18 and 64 for American males with four years secondary education as compared to those with less than eight years of education. His estimate of lifetime earnings differences between the two groups amounts to $107,000. Our estimates based on the male, and male and female samples is $100,000 and $77,000, respectively, i.e., about 94 and 72 per cent of Miller's estimates. Parts of the difference are likely to stem from the nature of the two universes; other parts are likely to result from the fact that Miller's income estimates only have been adjusted for sex, education, age, and mortality, while our estimates have been adjusted for seven additional variables.

Spillover Estimates of Student Incremental Earnings

Students' incremental earnings spill over community boundaries through the combined forces of population migration and fiscal interaction (Chapter II). The disposable income portion of the student's incremental earnings does not spill over, it is assigned to the student's initial area of residence where he was educated. We shall only present empirical findings of benefit spillover between Clayton and the other five study areas, even though it was also necessary to estimate spillover between each of the other areas in order to make the Clayton estimates.

The residents of Clayton in 1959-1960 not only realized future benefits from initial period Clayton education, but also from public education provided elsewhere in that year. It is necessary, therefore, to estimate the magnitude of incremental earnings for students in all areas, prior to determining the amount of spillovers. These estimates were made based on the assumption that, as a result of the additional year of education, each student earns a constant increment of $151 annually (based on the $210 estimate—see Tables 75 and 76—adjusted for the lower labor force participation rate of women) during his working lifetime, irrespective of his future area of residence. Individuals were assumed to acquire the average annual mortality rate of their current area of residence. The present value ($3.9 million) estimates of Table 75 clearly understate total added earnings benefits since, by assuming that all residents of an area have the same average rate of mortality, expected student mortality is clearly overestimated in early years of the student's life when annual incremental earnings make a larger contribution to present value, and underestimated in later years when added earnings make a smaller contribution to present value.

In order to facilitate the computation and presentation of tax benefit spillover, tax spillover was analysed by level of government levying the tax burden, rather than by individual tax revenue sources. The federal government was assumed to finance its operations solely through the individual income tax, state governments to finance their operations through state sales-excise and individual income taxes, and local governments to

Table 75

Estimated Present Value of Total Student Incremental Earnings

By Area of Education, 1959-1960 (5% Discount Rate)

Area of Education	Incremental Earnings ($ million)
1. Clayton School District	$ 3.7
2. Rest of St. Louis County	194.1
3. City of St. Louis	162.4
4. Rest of SMSA	187.8
5. Rest of Missouri	842.0
6. Rest of United States	56,265.2
TOTAL	$57,655.2

Table 76

Present Value of Spillout (From) and Spillin (To) Clayton of Federal-State-Local Government Student Tax Burden Benefits: Area of Education Origin and Area of Residence of Tax Beneficiary in 1960 ($000)

	FEDERAL			STATE			LOCAL			TOTAL		
Area	From	To	Net	From	To	Net	From	To	Net	From	To	Net
1	—	0	0	—	0	0	—	1	1	—	1	1
2	2	3	1	7	10	3	13	21	8	22	34	12
3	2	2	0	8	8	0	9	13	4	19	23	4
4	1	3	2	2	6	4	3	7	4	6	16	10
5	6	12	6	27	39	12	8	21	13	41	72	31
6	440	796	356	120	128	8	118	210	92	678	1,134	456
TOTAL	451	816	365	164	191	27	152	273	121	767	1,280	513

rely solely upon the general property tax. At the state level, the spatial sales-excise and individual income tax coefficients were weighted according to their respective revenue contributions for 1960. The spatial tax coefficients developed for the cost spillover analysis were utilized in making the estimates of tax benefit spillover.

The total tax burden upon student incremental earnings of each level of government was assumed to be the same for students in all areas and constant over time. Furthermore, it was assumed that all students incur an added burden equal to the estimated tax burden upon families in 1958 at the $4,000-6,000 level of income—the average income level of a high school graduate.[23] Thus, we exclude additional tax burden the student may incur as a result of education beyond the high school level, or which is the result of added on-the-job training and experience. Specifically, we assumed all students attain a high school education, and incur an added federal tax burden of 12.1 per cent, an added 4.4 per cent state, and an added 4.1 per cent local government tax burden on incremental earnings throughout their working lifetime.

Clayton's spillover of federal-state-local government tax burden benefits is summarized in Table 76. Of an estimated $3.7 million in total present value of Clayton student incremental earnings, $767,000 or approximately 27 per cent spilled over to residents of other areas. Over half of Clayton's tax benefit spillout ($451,000) was through federal government-levied tax burden, with the remaining portion about equally divided between state and local government-levied burden. Almost 90 per cent of the tax benefit spillout went to taxpayer beneficiaries who were residents of the rest of the United States during the period Clayton students received their education. Of the remaining 10 per cent, about half was spilled out to residents of the rest of Missouri, and the other half was equally shared with the rest of St. Louis County and St. Louis City. While 97.3 per cent of Clayton's federal government-levied tax benefits were spilled out to the rest of the United States a somewhat lower proportion—73 and 77 per cent—of state and local government-levied tax benefits, respectively, were spilled out to residents of area 6.

Residents of Clayton in the initial period, however, were recipients of $1,280,000 in present value incremental tax benefits from students educated during the initial period in all other five study areas. Almost 89 per cent of this tax benefit spillin was from students educated in the rest of the United States, about half of the remaining portion (5 per cent) was spillin from the rest of Missouri, and the remaining 6 per cent was spillin from the other areas. About two-thirds of the benefit spillin was through federal government-levied taxes and the remaining third through state and local government-levied tax benefits.

Clayton residents thus realized a net tax benefit spillin of $513,000, of which about 89 per cent was from the rest of the United States, 6 per cent from the rest of Missouri, and the remaining 5 per cent from the other three areas. Clayton had a net positive benefit spillin balance with all areas. Clayton residents realized about $4.2 million in total student incremental earnings benefits from education provided in all areas—$2.9 million in benefits from their own locally provided education, the portion of total benefits which did not spill over, plus $1.3 million in benefits from education provided in all other areas, the spillin portion of total public education benefits.

Chapter XI

THE CHILDCARE VALUE OF PUBLIC EDUCATION: INCREMENTAL EARNINGS OF MOTHERS

Although the main objective of education is increased knowledge and skills of students, a variety of incidental by-products can result. One such incidental, but nonetheless valuable, by-product is the direct, short-run childcare service provided by the schools to mothers. Once a child enters school, he no longer requires the full-time attention of his mother who, because of custodial service provided by the school, is then free to seek gainful employment or to engage in other activities. The difference between a mother's output before and after her child enters school reflects the increment of social output attributable to the provision of education. Production possibilities increase because the custodial services of schools permit reallocation of resources.

Theoretical Considerations

Custodial childcare offered by schools enables mothers to engage in either market or non-market activities. Of these alternatives, we assume that a mother chooses the most profitable activity, basing her decision on a kind of benefit-cost calculus. In the abstract, such a calculus includes both market and non-market factors. The major market benefit is an increase in earnings, although consumption aspects, such as superior working and social conditions, are also considerations. The benefits of work at home include the value of domestic service, childcare, the opportunity for leisure, plus the consumption and investment aspects of caring for and informally educating one's own children.

This analysis recognizes the existence of both market and non-market benefits. However, because the quantification of non-market aspects is most difficult, this study includes only market benefits when attempting to quantify the increment of social output attributable to the provision of education—benefits which are either directly valued in the market place, or whose value may be indirectly measured through market counterparts.

Let us consider what can happen when the only or youngest child reaches school age. Prior to a child's entry into school, the mother is either engaged in full-time activities at home or in the labor force, or is engaged part-time in both. For simplicity's sake, we will disregard the part-time activities.[1] Thus, mothers who choose between market and non-market activities once their child enters school can reallocate their time in one of four different ways (Table 77).

In the first situation (Case I), a mother formerly at home enters the labor force, i.e., market activities are substituted for non-market activities. If decisions reflect benefit-cost burden considerations, it can be assumed here that the difference between total benefits and costs of employment for a mother after the child enters school exceeds the difference between total benefits and costs of remaining at home.

As a second alternative (Case II), the mother remains at home. She may prefer additional leisure or other non-market activities, or her potential additional market productivity (salary) may be insufficient to do more than cover the additional costs of obtaining a job. A substitution

Table 77

Classification of a Mother's Activities Before and After Her Children (Child) Enter (s) School*

	Before the child enters school the mother is	
	at home	in the labor force
After the child enters school the mother is at home	II	IV
in the labor force	I	III

* Roman numerals correspond to the discussion in the text.

of one non-market activity for another takes place.

In the third instance (Case III), some mothers, already employed in the labor force on a full-time basis before their children enter school, may simply prefer remaining at their outside jobs. These mothers have no incentive to reallocate their activities, since they are already engaged in their highest net productive activities. Although childcare fees have been eliminated, institutional rigidities or the desire for leisure may keep them from engaging in still further market activities. Total social output of these mothers remains unchanged. The increase in their disposable income, which results because they must no longer pay childcare fees, is a transfer payment to the mothers from taxpayers, who finance the cost of education.

And finally (Case IV), there are those mothers who may now prefer substitution non-market for market production because of a personal dislike of caring for their own children, that is, because her child is now in school, the mother no longer has to work to avoid childcare. We might expect few mothers to fall into this classification.

Conceptually, the difference between a mother's output before and after her child enters school indicates the social output increment attributable to the provision of education. However, because of the difficulty in identifying and measuring non-market costs and benefits pertaining to reallocated activities of mothers, we shall include in our analysis of childcare benefits only reallocations of mothers' activities from household to labor force after the child enters school (CaseI).

To estimate the increase in tangible output per working mother resulting from her child entering school, we substract from the mother's wages (assumed to equal the value of her marginal product) the opportunity cost of going to work—those additional costs incurred because of outside employment—plus the estimated value of the mother's prior non-market output. The difference between the mother's market output after her child enters school and her estimated non-market output prior to school attendance reflects an increment in output attributable to the provision of education.

Let us consider in more detail the estimation of increments and social output of mothers who enter the labor force after their last child enters school. The mother's wage payment can be considered the gross addition resulting from her entering the labor force. It may be approximated in terms of the average full-time wage rate of women who newly enter or re-enter the labor force (Line 1 of Table 78). From this wage figure three types of costs must be deducted. The first group of costs is associated with expenses of working away from home. It includes transportation costs, e.g., the round-trip cost of public transit (Line 2a), and the additional clothing costs of mothers who work away from home (Line 2b). In the absence of better information, it is assumed that these additional clothing costs are a fixed proportion of the mother's wages, e.g., 5%.

A second group of costs relates to the decrease in the mother's domestic output and childcare services once she accepts employment (Lines 3a and 3b). The value of the mother's former domestic service may be estimated conservatively as the cost of hiring a full-time housekeeper. The value of childcare service which the mother formerly performed can be looked upon as the difference between the cost of hiring a full-time

Table 78

Increment in Social Output of Mothers in the Labor Force After Last Child Enters School

1. Mother's earnings (value of market output)

Less 2. Costs of working away from home as compared with working at home:

a. Transportation costs

b. Additional clothing costs

Less 3. Estimated value of decrease in mother's domestic output and childcare services:

a. Estimated value of domestic service

b. Estimated value of childcare service

Equals 4. Estimated increment in value of output

Less 5. Added tax burden resulting from mother's labor force participation.

Equals 6. Estimated increment in value of mother's net private income housekeeper (who performs domestic as well as childcare services) and the cost of hiring a full-time maid (who performs domestic services only). The cost of hiring a housekeeper is likely to be a conservative estimate of the mother's former domestic output because of her supervision of domestic help and the possible reduction in the quality of services. Similarly, the childcare service of the schools is not likely to provide the personalized attention of the home.

A third cost is the added final direct and indirect tax burden of all federal, state, and local government tax levies incurred by mothers in relation to their incremental income (Line 3). The mother's direct federal and state personal income tax burden may be estimated as the net additional income tax liability of husbands and wives who file joint personal income tax returns before and after the mother joins the labor force. This direct tax liability, which is also assumed to be a final tax burden, can be estimated by multiplying the marginal family income tax rate by the gross wage payment of the mother (Line 1).

The additional indirect tax burden is the result of all other taxes, excluding social insurance, which rest as an ultimate burden upon the mother (or her family) in relation to her additional income. This burden is the result of either shifting taxes forward as part of consumer product prices, or backward upon factor prices (incomes). The mother's added indirect tax burden may be estimated from studies of tax burden by income class, based on the assumption that indirect tax burden as a proportion of income varies by family income class but is identical for a given family income level in all geographic areas of the country.

Subtracting these three types of costs from a mother's increased output as measured by her wages will yield the estimated increment of the mother's net private income (Line 6) resulting from the school's child-care services. The sum of a mother's added net private product and her (or her family's) additional net tax burden is the increment in her social output from employment in the labor force.

Empirical Estimates of Childcare Value of Public Education

Procedures will be developed first, to estimate the average net increase in mothers' net private income after the last child enters school; second, the total childcare value of public education in the six study areas; and third, benefit spillover in terms of the tax savings of the six study areas.

A procedure to estimate the average net increase in value of mothers' output in the labor force after the last child enters school, in 1959, is presented in Table 75. The average annual wage of full-time employed females in 1959 was $3,205. Since wages of new labor force entrants tend to be somewhat below the average figure, this figure was reduced by 10 per cent to $2,885. Since public schools offer childcare services only during 36 weeks of the year, the earnings figure was further reduced by multiplying it by .62.[2] The residual earnings figure of $1,789 was then adjusted for costs of working away from home—$.30 per day for public transportation for 180 days and 5 per cent of wages as added cost of clothing. A further adjustment was made for the decrease in the mother's domestic output—62 per cent of the average 1959 annual wage of domestic servants of $1,214, or $842. The average net increase in the value of tangible output was thus estimated to be $765 (Line 4). It was further estimated that of this figure, on the average, approximately eight-tenths ($621) constitute federal, state, and local tax burdens. The remainder ($144) is the average net increase in mothers' private income (Line 6).

Table 79

Average Net Increase in Value of Output for Mothers in the Labor Force, After Last Child Enters School 1959

1. Mother's Earnings:

   a. Average annual wage of full-time employed female, 1959: $3,205*

   b. Multiplied by 90 per cent (the assumed lower wage scale of new labor force entrants): 2,885

   c. Multiplied by the per cent of working time children are in school (28 weeks/45 weeks = 62.23 per cent): 1,795

Less 2. Costs of Being Gainfully Employed:

   a. Average cost of getting to and from work by public transit ($.30 per day times 180 days): = 54

   b. Added cost of clothing (2 per cent of $1,795): = 36

Less 3. Estimated Value of Decrease in Domestic Output:

   a & b. Average cost of hiring a housekeeper (1959 annual wage of domestic servants, $1,514, times 62.23 per cent)*: = 940

Equals 4. Average net increase in value of output: $ 765

Table 79

Part ii

Less	5.	Additional (family) tax burden from mother's labor force participation: (34.6 per cent of Line 1c)**	- 621
Equals	6.	Average increase in mother's net private income:	$ 144

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* U.S. Department of Commerce, Bureau of the Census, Statistical Abstract of the United States, 1961 (U.S. Government Printing Office, Washington, D.C., 1961), Table 440, p.322.

** The 26.1 per cent federal tax burden rate is the sum of the 20 per cent marginal federal income tax rate on average family income in the U.S. in 1960, plus the estimated 6.1 per cent burden of federal excise and customs taxes on mean family income; the 4.4 per cent state tax rate is the sum of .6 state personal income, .1 state corporate income, and 3.7 per cent state sales and excise taxes as a per cent of mean family income; the 4.1 local tax rate is the estimated burden of property taxes as a per cent of mean family income; George A. Bishop, "The Tax Burden by Income Class, 1958," National Tax Journal, Vol. XIV, No. 1, March, 1961, Table VI, p. 54.

General accuracy of the estimate can be verified by estimating the money outlay for childcare service which these mothers would make if there were no schools.[3] With standards of a 6½-hour school day and a 180-day school year, the childcare value before taxes is estimated at $877 at a $.75 hourly market childcare wage rate, $585 at a $.50 hourly wage rate, and $765 (the net value of tangible output measure) at $.65 per hour, the latter figure being a reasonable average childcare expense. Working mothers thus realize a net private income benefit of education for childcare services about equal to the direct per student cost of providing the education itself.

A procedure for the estimation of total childcare value of public education for the six study areas is presented in Table 80. Here we estimate the number of mothers with children ages 6 to 11 initially beginning work when their last child entered school in 1959.

In March, 1960, there were a total of 52.4 million women who had ever been married of which 32.7 per cent or 17.1 million were in the labor force.[4] Of these women in the labor force, 5.1 million had children between 6-17 years of age, and 2.9 million had children less than 6 years of age. Since the 2.9 million working mothers with children less than 6 years of age must still provide childcare service for their preschool children, we shall assume there is no reallocation in their work activities (Case III). Of the 5.1 million married women with children 6-17 years old only, 48.8 per cent had children 12-17 years old. Thus, as of March, 1960, there were 2.624 million mothers with children aged 6-11 and none less than 6 in the labor force—about 42.5 per cent of all such mothers in the civilian population. The 1.4 million mothers with children ages 6-11 who also had children ages 12-17 are included within

Table 30

Total Childcare Value of Public Education by Area, 1959-1960

	(1) Estimated Total No. of Working Mothers with Children (6-11) in Public School who First Enter the Labor Force After Youngest Child Enters School	(2) Per Cent Public School Students	(3) Estimated Total No. of Working Mothers with Children (6-11) in Public School (1)x(2)=(3)	(4) Total Increase in Mother's Net Private Income by Area, or (3)x$144* (in $000)	(5) Total Net Increase in Tax Burden Payments, or (3)x$621* (in $000)	(6) Total Childcare Value by Area or (3)x$765 (in $000)
1. Clayton School District	151	63.0	95	$5.5	$67.2	$72.7
2. Rest of St. Louis County	4,684	67.2	3,148	453.3	2,051.3	2,504.6
3. City of St. Louis	7,051	71.8	5,063	729.1	3,144.5	3,873.6
4. Rest of SMSA	3,770	79.9	3,012	433.7	1,870.8	2,304.5
5. Rest of Missouri	19,361	91.1	17,638	2,539.9	10,954.4	13,494.3
6. Rest of U.S.	1,342,983	86.3	1,158,994	166,895.1	719,816.3	886,711.4
Total	1,378,000		1,187,950	$171,056.6	$737,904.5	$908,961.1

* Since mean family income of Clayton and the rest of St. Louis County is higher than for the other areas, total tax burden was estimated as 39.3 and 36.3 per cent of gross income for these two areas respectively (Table 81), as compared with 34.6 per cent for the other areas.

the total of 2.6 million working mothers. Although 12-17 year old children presumably do not require childcare, we assume they cannot accept the responsibility of caring for younger brothers and sisters; should they be able to do so, there is an opportunity cost involved—they could also care for children of other mothers.

Since some of these 2.6 million working mothers probably were already in the labor force when their last child entered school, they have not reallocated their activities. Of all women in the civilian population with children under 6, 20.2 per cent were working mothers; therefore, it is likely that the same proportion of all women in the labor force in the civilian population with children 6-11 years of age were already employed when their youngest child entered school. Thus, an estimated 1.4 million mothers currently employed ($\frac{42.5-20.2}{42.5} = 52.5\%$ and $52.5\% \times 2{,}624{,}000 = 1{,}378{,}000$) with children 6-11 years of age initially began work when their last child entered school.

Column 1 of Table 80 allocates to the six study areas, the 1.4 million working mothers with children 6-11 years old in public schools who first enter the labor force after the youngest child enters school. Here we assume that the proportion of these mothers in the six study areas was equal to each area's ratio of 1960 employed female population in the United States.[5] The number of such mothers in each area with children in public schools is proportional to the percent of all elementary and secondary public school students in each area (column 2).

By multiplying the information in column 3 by the estimated total net increase in mothers' private income, $144, area figures are obtained. In a similar manner also, area figures for total net increase in tax burden payments are obtained in column 5. By adding the information in columns 4 and 5, the total childcare value by area is obtained in column 6.

The estimate that on the average only 19 per cent of the total childcare value of education accrues to mothers as net private income may largely explain the relatively low labor force participation rate of mothers, even after their last child has entered school.

The procedure for estimating spillover of the tax burden portion of mothers' childcare benefits (Table 80, column 5) is identical to that for estimating tax benefit spillover with a stationary population (Chapter IX). By assumption, mothers are residents in the area in which their children go to school, and mothers and non-parent taxpayers migrate only at the end of each period. As in the case of student tax benefit spillover we assume that: (1) the total tax burden of mothers is a function of median family income; (2) the tax burden, while varying by income level, is the same throughout all areas; and (3) the average tax rate in all areas is the same.

The tax burden portion of the total childcare value of education, as previously explained, was estimated by multiplying the rate of tax burden (tax burden as a per cent of median family income) times the gross income of mothers who join the labor force (Table 79). That is to say, a mother's added tax burden upon entering the labor force is not only the result of her increased total output (income), but is also the result of reallocating taxable labor force output (income) for the non-taxable output (income) of her previous household activities.

Part of a mother's additional tax burden is the result of spending part of her increased gross income (output) on costs of employment (assumed 10 per cent of gross income). As a result, the estimate of tax burden as a proportion of net social output (income) is somewhat overstated. Since approximately 14 per cent of median family income in the United States is absorbed as indirect tax burden, and since 10 per cent of the mother's gross incremental income was subtracted as a cost of employment, incremental tax burden as a percentage of net social output might be overstated by as much as 1.4 per cent (10% x 14%).

On the basis of median family income by area, the mother's incremental tax burden as a percentage of incremental gross income is summarized by area and by level of government in Table 81. Total tax burden of mothers in area of residence by level of taxing government may then be derived by distributing each area's total increased gross income (number of mothers x $1,795) by the tax burden coefficients by level of government which originated this burden. Thus, the total tax burden dollar amounts of Table 81 are the entries of the estimated total net increase in tax burden payments of Table 80.

Spillover of the tax burden portion of the increased childcare value of education between our six study areas are then estimated by level of government (Table 82). As explained in Chapter IX, these tables were computed by: (1) distributing each area's tax burden according to level of taxing government, and by area in which this tax burden originated (Table 65), and by (2) further redistributing the tax burden according to the tax shifting pattern of each area originating tax burden, assuming that those areas that realize increased tax burden revenue lower their average tax rates (Table 64). Since the childcare value of education results only in current (period t_0) benefits to mothers, it is not necessary to discount and sum a flow of benefits over time as we do with student benefits.

Table 81

Tax Burden on Mothers' Gross Earnings by Level of Taxing Government, by Area (in percentages and dollars)

Per cent Taxes

Area	Federal	State	Local	Total
1	32.3	4.2	2.8	39.3
2	28.0	4.6	3.7	36.3
3	26.1	4.4	4.1	34.6
4	26.1	4.4	4.1	34.6
5	26.1	4.4	4.1	34.6
6	26.1	4.4	4.1	34.6

($000)

	Gross Income	Federal Taxes	State Taxes	Local Taxes	Total Taxes
1	$171	$55.2	$7.2	$4.8	$67.2
2	5,651	1,582.3	259.9	209.1	2,051.3
3	9,088	2,372.0	399.9	372.6	3,144.5
4	5,407	1,411.2	237.9	221.7	1,870.8
5	31,660	8,263.3	1,393.0	1,298.1	10,954.4
6	2,080,394	542,982.8	91,537.3	85,296.2	719,816.3
	$2,132,370	$556,666.8	$93,835.2	$87,402.5	$737,904.5

Table 82

Tax Reduction Benefits Originated and Realized by Clayton Through Federal, State, and Local Taxes on Mothers' Earnings, 1959-1960 ($000)

	Benefits realized by Clayton residents from taxes on earnings of mothers in all areas				Benefits realized by residents of all areas from tax burdens borne by Clayton mothers on their earnings			
	(1) Federal	(2) State	(3) Local	(4) Total	(5) Federal	(6) State	(7) Local	(8) Total
1. Clayton School District	0.0	0.0	0.5	0.5	0.0	0.0	0.5	0.5
2. Rest of St. Louis County	0.6	1.2	2.4	4.2	0.3	0.9	0.7	1.9
3. City of St. Louis	0.8	1.9	3.2	5.9	0.2	0.8	0.5	1.5
4. Rest of SMSA	0.5	0.6	1.0	2.1	0.2	0.1	0.2	0.5
5. Rest of Missouri	2.9	6.7	4.2	13.7	0.6	2.7	0.4	3.6
6. Rest of U.S.	193.0	4.5	21.2	218.7	53.9	2.6	2.5	59.0
Total	197.8	15.0	32.5	245.2	55.2	7.2	4.8	67.2

* Figures may not add to totals because of rounding

With regard to the total federal tax burden on childcare income of education, Clayton had a net spillin of $143,000 (Table 82, column 1 minus column 5). Although Clayton mothers spilled out all of their additional federal tax burden, Clayton residents were recipients of $198,000 in federal tax reduction benefits resulting from additional federal tax burdens of all other mothers. Both Clayton's spillout and spillin were mainly with residents in the rest of rest of the United States.

Clayton spilled out $7,000 in state tax burden benefits, but again more than compensated for this by spillins of $15,000, for a net state tax benefit of $8,000 (Table 82, columns 2 and 6). However, spillovers were more evenly divided by area, with the largest net state tax benefit spillin of $4,000 with the rest of Missouri.

Clayton realized the highest ratio of tax benefit spillin to spillout with regard to local tax benefits, in which the $32,500 benefit spillin exceeded the $4,800 spillout by a ratio almost 7 to 1 (Table 82, columns 3 and 7). Clayton had a net spillin from each area, but the largest net spillin of $19,000 again was with the rest of the United States.

Considering the combined tax benefit spillover of all three levels of government (Table 82, columns 4 and 8), Clayton spilled out $66,700 of a total of $67,200 of locally-generated childcare tax benefits. However, it spilled in an estimated $244,700 of childcare tax benefits from all other areas for a net positive benefit spillin balance of $178,000.

Chapter XII

Indirect Benefit Spillover

The preceding two chapters considered the spatial and temporal dimensions of direct social benefit spillovers of public education. These are benefits which initially accrue directly to the household for which the service is rendered—the student and his family. In this chapter attention will be given to intercommunity spillovers of indirect social benefits. These are benefits which initially accrue to individuals and households other than the direct public education beneficiaries.

Our analysis is limited to benefits which are realized through activity in the market place, or for which a market counterpart exists. Transfer benefits—those which result merely in a change in relative prices and therefore in a redistribution of social benefits among beneficiaries without contributing to the total—are omitted. The importance of indirect benefits should not be measured by the brief treatment accorded them here, which is made necessary by the limitations of our study.

We will examine four indirect benefits: (1) employment related benefits—especially benefits to co-workers; (2) the reduced cost of such public services as police and fire protection, resulting from the presence of educated individuals in the community; (3) informal education benefits to the student's future family; and (4) the general benefits of education, widely diffused, which accrue to society as a whole. In some instances, rough estimates of their magnitudes are made; in other cases only the general direction toward possible benefit measurement is indicated. Procedures for modifying the general spillover model used in the analysis of direct benefit spillover are explained and demonstrated in the analysis of indirect benefits, but spillover estimates for the case study areas are not presented.

Employment Related Benefits

One benefit of education is that it improved the general environment within which goods and services are produced, which in turn can raise the level of worker productivity. Most market production in modern economies requires coordination, cooperation, and interaction of numerous workers. Consequently, the productivity of every worker in the group influences the productivity of every other worker. Since additional education not only can increase the student's future on-the-job productivity but also can improve the general environment within which production takes place, future co-workers have a financial interest in his education.

Within a perfectly competitive wage structure employers pay workers the full value of their marginal product; there is no exploitation of a worker's productivity. However, workers do interact with fellow workers in the productive process. By emulating his co-worker a worker may learn his skills. Alternately, increased productivity may arise from psychological and motivational factors which result from work association. The education of one worker may thus have a favorable external effect on the productivity of others. An employer may contract to pay each worker his marginal product, but for lack of institutional arrangements whereby educated workers can appropriate "environmental" benefits which subsequently accrue to co-workers, both the marginal productivity and wages of the co-worker are likely to increase.

Co-workers may benefit from an improved general working environment in various ways. In the first place, education develops skills such as communication, flexibility, and adaptability. Co-workers may learn these skills through work contact and thereby increase their productivity. No doubt some of the increased wages which usually accompany added experience result from external benefits realized by co-workers. Education also disciplines the mind; vigorous personal and psychological traits such as circumspection, reliability, and maturity may be communicated in part to fellow workers, whose productivity in turn is raised.

Particular types of knowledge may also be transferred to co-workers through job relationships with workers who received elementary and secondary schooling. Educated workers need not make a contribution to new knowledge in order that fellow workers may benefit. Merely by their presence, educated workers may deepen the usefulness of present knowledge through the transfer process. Edward Denison states that "there can be little doubt that the increase in education received by executives and specialized key personnel as well as the ordinary worker, and the awareness of and receptivity to new ideas that is engendered by education, have facilitated both the recognition of improved practices on the part of management and the possibility of quickly incorporating them into the productive process."[1] Although new technological or managerial knowledge is of universal benefit to all people, a deepening of the present state of knowledge through workers who in their youth achieved an elementary and secondary schooling may be assumed of benefit to co-workers with less or no education.

Workers can benefit in various ways from learning on the job. It is instructive to distinguish between environmental benefits resulting from educated co-workers and other on-the-job learning benefits. Learning on the job encompasses both formal training programs and informal instruction in a job situation without any specific educational activities arranged by the employer. Formal on-the-job training may be defined as a learning process paid for by an employer, guided by a supervisor, and designed as instruction for the job assigned to an employee.[2]

At least three types of informal on-the-job training may be distinguished: training of newly hired personnel, which results in an increase in firm costs due, for example, to low productivity, increased supervision and maintenance, or to higher accident and inspection costs; informal "learning from experience"—the gain in speed and accuracy resulting from job repetition; and the informal training of less educated workers through the automatic "by-product" on-the-job association with more educated co-workers.

Learning on the job may be regarded as an investment by the worker if and insofar as he "invests" something in expectation of future benefits, i.e., the current sacrifice of higher earnings from alternative activities in the hope of still higher earnings in the future. However, some occupations afford a chance for improvement without requiring a sacrifice of higher earnings in the early years. Likewise co-worker benefits may partly be anticipated while others are external to the job decision.

Gary S. Becker and Jacob Mincer have developed a theoretical connection between the cost of on-the-job training provided by the employer and the cost of on-the-job learning incurred by the employees in the form of foregone earnings in other jobs.[3] Using an abstract model of a perfect labor market in which there is perfect competition both among firms in buying and among workers in selling their services, both training and learning cost would be reflected in the rates of earnings and, hence, be borne entirely by the worker. With learning costs and training costs accounted for in the demand and supply functions for labor services, the equilibrium earning rates would reflect both costs.

The problem of estimating the investment and the rates of return on the investment in on-the-job training is very intricate. Utilizing a year-by-year procedure for estimating training costs by comparing two average income-streams of workers differing by levels of schooling, Mincer estimates total investment in training at school and on the job for United States males, 1939, 1949, and 1958, by level of schooling.[4] Total estimated investment in on-the-job training in 1958 in current dollars was $13.5 billion, of which an estimated $1.0 billion was for workers with an elementary education, $3.8 billion for workers with a high school education, and $8.7 billion for workers with a college education.

Mincer uses a broad concept of on-the-job training. The term "training" denotes investment in acquisition of skill or in improvement of worker productivity. Psychic components of real earnings, however, are not included in the measure. His concept of on-the-job training "includes formal and informal training programs in a job situation, as well as what is called 'learning from experience.' " All on-the-job training is treated as an investment, assuming that an individual takes a job with an initially lower pay than he could otherwise get because he knows that he will benefit from the experience gained in the job taken.

While in theory Mincer is including informal co-worker training in his estimates of on-the-job training, he is unable to value the separate components. Such identification would be possible if data were available on earnings of two comparable groups of workers, one group working with more educated co-workers, and another group not exposed to the same informal education.

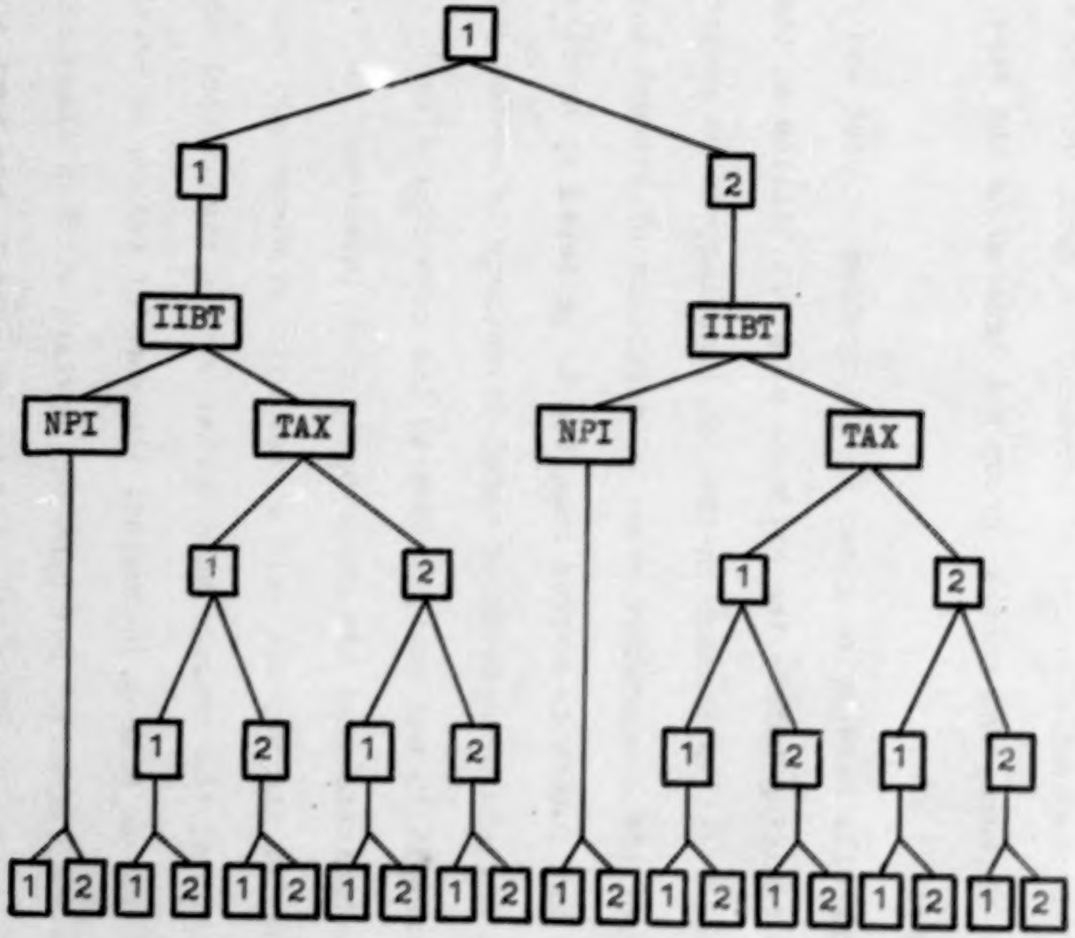
More thought will have to be given to the problem of cost and returns from on-the-job training before the estimate of $13.5 billion as the 1958 investment in human skills through on-the-job learning can be accepted. Some indication of the comparative order of magnitude of student incremental earnings and future co-worker benefits is achieved by arbitrarily assuming that a certain proportion of total investment in on-the-job training, for example 10 per cent, is due to the co-worker effect. Mincer's estimates indicate that the opportunity cost investment in 1958 on-the-job training for the average male worker with an elementary education was $200, and that of the average male worker with a high school education, $280.[5] If, as Mincer indicates, the rate of return on on-the-job training is 19.3 and 15.1 per cent for workers with an elementary and high school education, respectively, and if at least 10 per cent of these future earnings benefits are the result of elementary and secondary education of co-workers, the annual benefit to workers with an elementary and high school education from education of co-workers is $24 and $32, respectively. In comparing these sums with the estimated average $210 incremental earnings of both male and female students (Chapter X), it must be remembered that the benefit to workers is probably the result of all 8 or 12 years, rather than the last year, of their co-workers' formal education.

The mechanism of spatial spillover of student education benefits to co-workers is illustrated by Fig. 13. In the initial decision-making

Fig. 13

Spatial Spillover of Educated Worker's Incremental Earnings to Co-worker

1. Student educated in district
2. Migration models show that in the future, the student works in district
3. Co-workers realize incremental income before taxes through association with students at work
4. Co-workers incur incremental tax burden on gross income
5. Tax spillin models show that the added tax burden is from levies of districts
6. Tax spillout models show that tax reduction benefits are realized by future residents of districts
7. Migration models show beneficiaries resided in time (t_0) in districts



Legend: IIBT — Incremental Income Before Taxes NPI — incremental Net Private Income
TAX — incremental direct and indirect TAX burdens

At the same time students are educated in area 2, such that when Line 1 represents area 2, an entry of 1 on Line 7 represents benefits spilled out from area 2 to area 1, and an entry of 2 on Line 7 represents area 2 benefits not spilled out. The entries on Lines 2 through 6 remain the same in either case.

period students are educated either in district 1 or district 2, representing all other districts (Line 1). In future periods, students may migrate to other areas where they are employed (Line 2). In these future areas of work and residence, co-workers of students, through associations at work, realize incremental income before taxes (Line 3). Part of the incremental income, however, is paid to government through increments in direct or indirect tax burdens (Line 4). Tax burden spillin models can be used to allocate the added tax burden to areas 1 and 2 (Line 5). Assuming that demand for government services is independent of education and income and that governments balance budgets by reducing average tax rates, tax spillout models allocate tax reduction benefits to future residents of districts 1 and 2 (Line 6). For purposes of political decision-making, however, tax reduction beneficiaries as well as co-workers who realize net private income benefits are identified according to their initial area of residence, i.e., where they had lived in time (t_o) (Line 7). Thus, with only minor changes, the model developed for estimating student incremental earnings spillover can be adapted to the analysis of spillover of indirect benefits initially realized by future co-workers of students.

Public Services Benefits

Optimistically, the presence of educated individuals in a community can, over time, lead to a decline in police protection costs associated with combating crime and delinquency, in law enforcement costs, and in welfare payments. The presence of educated persons, moreover, may also reduce health and fire hazards.

This reduction in the need for public services (and the consequent reduction of tax revenues) may result directly from additional education. The reduction may also result from increased income accompanying additional education, which in turn reduces the need for other public services, such as welfare aid. For example, some portion of criminal behavior can be attributed to a lack of education, and that portion would be a social cost.[6]

In his analysis of the external fiscal benefits of education, Burton A. Weisbrod identifies two parts: resource cost benefits; and pecuniary (transfer payment) benefits.[7] Weisbrod cites one example of external resource cost benefits—the case of illiterate adult males who were unable to serve in the Armed Forces during World War II without additional military educational programs. Sixty per cent of these illiterates were from the southeast part of the country; the primary burden of supporting this education was transferred from local to federal sources, which Weisbrod modestly estimated to have cost $45 million. An example of a pecuniary external benefit is the reduction in statewide unemployment compensation tax collections accompanying additional education. A community that actively discourages drop-outs, he argues, tends to reduce the unemployment tax burdens on the remainder of the state, even if the drop-outs do not migrate. Weisbrod recognized that, from an overall social point of view, income transfers and real benefits of education are not normally additive.

In 1960 the average level of education, measured by the median number of completed school years for those 25 years of age and over, was 10.6 for the United States. It varied from a low of 8.8 years for the east, south, and central states to 12.0 years for the western states. However, the range is considerably greater within states and counties. For example, in St. Louis County during that year, the median number of completed school years for persons 25 years of age and over ranged from 8.3 years for Kinloch to 13.8 years for Ladue.[8] These wide differences in the number of years of schooling suggest that when persons with little education move into political jurisdictions with a higher level of educational attainment, they may be handicapped by a lack of schooling and can constitute a social problem, with a consequent expansion of public service costs.

Because of high population mobility the cost of inadequate education in terms of large service demands tends to be borne by persons external to the education decision. Communities which experience substantial in-migration of poorly educated persons with large welfare service needs realize the desirability of more and better education throughout the nation, especially in the areas from which the migrants had come.

A local district's decision to provide improved education results in the spillover of reduced social cost benefits to residents of other communities through the combined forces of population migration and fiscal interdependence (Fig. 13). Here, however, the mechanism of fiscal interdependence is somewhat different. Because the in-migrant received more education in his former area of residence, his new community will benefit from having to increase social service expenditures less than had he been poorly educated.[9] The lower differential social service expenditure initially accrues entirely to a migrant's new area of residence. The tax reduction benefits of the reduced expenditures, however, ultimately accrue to various communities according to the tax-reducing area's spatial tax spillout coefficients.

Education Benefits to Student's Future Family

Another benefit of education is that, other things being equal, the future home of the educated person offers a better intellectual environment than that of the non-educated person; therefore the student's children benefit from his or her education by informal education in the home. Informal education at home includes not only intellectual stimulation, or assistance with homework, but it affects the entire environment, enabling children to appreciate and utilize their formal education. As a result future earnings of a second-generation educated family are likely to increase.

The effective perpetuation of education rests with formal education in the school, transfers of education through social interaction on the job, and informal education in the home. Theodore W. Schultz stresses the importance of the latter: "The education of women...reduces the subsequent effective costs of education because of the critical role that mothers play in motivating their children to obtain an education and to perform well while they are attending school."[10] Education may thus be said to have an investment component which leads to intergeneration benefits.

While the presence and relevance of informal education in the home are generally recognized, we have made no attempt to estimate its value. Let us briefly reflect on the possible ways to make such estimates. One method of obtaining information on the worth of informal education is to correlate educational attainments of parents with their children's achievement test scores, adjusting for variation in student ability and educational quality. A net positive correlation could be translated into equivalent years of schooling, perhaps valued at average cost. This method would indirectly measure benefits of informal education. These benefits could be translated in terms of reduced education costs by estimating the costs of formal training designed to achieve comparable results.

An alternative method of measuring the benefits of informal education is to correlate the student's wage earnings with the educational attainment of both his father and mother, adjusting for such independent variables as his own formal education, race, sex, etc. The present value of a net earnings increment, discounted back to the period of the parent's education, is the estimated value of intergeneration benefits at the time of the decision-making period.

The level of parents' education affects their children's level of earning through informal education in the home, and through influencing the degree of formal educational attainment, which in turn affects earnings. Even among recent students, education of parents, as distinguished from attributes of the student, was a major determinant of the amount of education received (Table 83). A higher educational attainment of the father appears clearly correlated with higher education of sons.

Fathers' education is, of course, intercorrelated with family income, but additional detail shows that each of the two, separately, was of great importance in determining the education received by sons. For example, among families with an income of $7,500 to $9,999, the percentage of sons with some college attendance was 32.9 for sons whose fathers did not graduate from high school, 57.7 for sons whose fathers graduated from high school but did not attend college, and 82.9 for sons whose fathers attended college (with or without graduating). Among sons whose fathers did not graduate from high school, the percentage with college

Table 83

Educational Status of Men 20 to 24 Years Old, Classified By the Amount of Education Received by Their Fathers

October, 1960

		Education of son (per cent of men 20 to 24 years old whose fathers had education specified)			
Education of Father	Total	Did not graduate from high school	High school graduate, no college	Some college, did not graduate	Graduated from or currently enrolled in college
Did not graduate from high school	100.0	42.6	34.1	7.8	15.5
High school graduate, no college	100.0	10.3	36.1	17.4	36.3
Some college, did not graduate	100.0	6.5	23.8	15.8	53.9
Graduated from college	100.0	4.0	8.2	10.1	77.8

Source: U.S. Department of Commerce, Bureau of Census, Current Population Reports, Population Characteristics, Series P-20, No. 110, July 24, 1961.

attendance was 12.6 where family income was under $5,000, 23.1 where income was $5,000 to $7,499, 32.9 where income was $7,500 to $9,999, and 40.8 where income was $10,000 or more. The highest percentage, 88.6, was for sons with fathers who had attended college and had a family income of $10,000 or more, while the lowest percentage, 12.6, was for sons whose fathers did not graduate from high school and had a family income of less than $5,000.[11]

A mother's level of educational attainment can also be expected to affect the education of her children. Comparing labor-force participation rates of women with children under six years of age and those with older or no children, Machlup estimates that $4,432 million was invested in terms of income foregone in preschool education by women with small children.[12] Machlup recognizes that there are also large benefits derived by mothers and children from informal education in the home in the form of current enjoyment and future capacities to live productive and happy lives. Assuming that mothers with more education in their youth create a better environment for informal education of children in the home than mothers with less education, then part of the prospective future return on the estimated total investment in preschool education may be identified with the initial decision to provide the mothers' additional education, and should be appropriately discounted back to this initial intergeneration decision period.

Turning next to a consideration of benefit spillovers of informal education in the home, it should be pointed out that these may be analyzed by using an adaptation of Fig. 13. Specifically, a person who in his youth had elementary and secondary schooling must first be followed from his place of education to his future place of residence and work, where he transmits informal education to his children (Line 2). In order to trace spatial spillover of benefits of the parents' education, Line 2a must be inserted in Fig. 13 so that second generation children may be followed from their former place of residence (with their parents, Line 2), to their future place of residence and work (insert Line 2a). The children realize incremental gross income in their future place of residence (Line 2a) as a result of informal education at home (Line 3) and there incur incremental tax burden (Line 4). The mechanism of fiscal interdependence of informal education benefits which follows (Lines 4 through 7) is identical to that of co-worker benefits. By tracing the spatial dispersion of benefits back to the parents' community of residence, we assume that parents include these intergenerational benefits to their future children when evaluating the advantages and disadvantages of an initial education decision.

General Societal Benefits

The indirect benefits previously discussed accrue to reasonably identifiable groups of individuals. There are other benefits of education, however, which are very widely distributed spatially and temporally so that the identity of the individual beneficiary is obscure. These "general" benefits may be considered under two classifications—immediate and intermediate general benefits. Most likely, only a small portion of each occurs in the market.

Immediate general benefits of education, although diffused throughout society, are considered to result in output increases which are directly attributable to additional education. The lack of trained persons in particular kinds of skills, for example, may thwart progress in underdeveloped segments of the economy. Additional education of these untrained people is desirable because important external benefits to co-workers may result. Due to the co-worker effect, the earnings of this group would understate the full value of their education.

Elementary and secondary education may be viewed as the basic building blocks of higher education, the groundwork for discoveries and inventions. This benefit is similar to what has been termed by Burton A. Weisbrod the "financial option" return of education.[13] Not only the student but society in general can profit should the student decide to seek higher education which may later aid in the discovery of new knowledge of benefit to all mankind.

Intermediate general benefits of education include all residual tangible increases in output which indirectly result from additional education. Education helps to create and maintain an environment in which improved productivity and output take place. Existence of a market economy, as well as the very maintenance of political democracy, requires widespread literacy—the principal output of elementary education. Effective communication of ideas and information through newspapers, magazines, and books would cease without widespread literacy; and the productive role played by checking deposits in our economy, or the facility of equitably collecting a major proportion of public revenue at low cost through the largely self-administered personal income tax, would likewise be severely limited.

Finally, education produces a variety of social benefits not amenable to the economist's monetary measuring rod. Education helps preserve and enlarge the cultural heritage of the country and strengthen its democratic institutions. It assists also in the attainment of general social goals, such as equality of opportunity. If financial or other obstacles to education prevent its achievement by some people, then further education of this group results in social benefits beyond the private benefits to the recipients of that education.

As we have previously indicated, the immediate and intermediate general benefits of education are distributed broadly both spatially and temporally through various mechanisms which tend to obscure the identity of the individual beneficiary. The fruits of new technology, eliminated production bottlenecks, or lowered cost of obtaining public and private funds, utilized by individual firms to develop new products or to lower costs of producing present products, are passed on to individuals in lower prices, improved quality, higher interest and dividend payments to owners, or increased wages to factor suppliers who share in the increased productivity. The spatial distribution of such benefits depends upon many considerations. Examples are area of residence of owners who benefit from education provided within individual local communities, the length of time over which the benefits are realized, the past and future areas of residence of the beneficiaries, and so forth. Thus, the benefits may be distributed among others, depending on level of income, pattern of consumer expenditures, and source of income.

Indirect benefits, as well as the basically intangible psychic benefits, may well be more consequential than the direct benefits which were previously analyzed. Much additional work is needed in this difficult benefit measurement task and in relating benefit spillover to the public education decision process.

Chapter XIII

SUMMARY OF BENEFIT SPILLOVER FINDINGS

The benefit analysis and empirical spillover findings of Chapters IX through XII are now summarized in order to consider their separate implications upon public education decision-making by a local community. First the estimates of benefit spillover between Clayton and the other study areas, from education provided in 1959-1960, are drawn together; then various major policies are considered, policies that the local community can utilize in its attempt to obtain further gross benefits from public education provided in all areas. Since some changes affect only benefit spillovers, evaluation of these changes permits definite conclusions as to their desirability. Other policy changes affect both benefit and cost spillover, but here only their effect on benefit spillover is considered.

The effects of policy changes upon benefit spillover are analyzed with respect to the three major components of benefit spillover, as summarized in Chapter IX, Fig. 12. First are policies which change the number of students and/or mothers who benefit directly from public education (Chapter IX, Fig. 12, Line 1). Second are policy changes which affect benefit spillover through changes in the rate and/or pattern of population migration (Chapter IX, Fig. 12, Lines 2 and 5). Third, are policies which change the rate and/or pattern of tax shifting, which, through fiscal interaction also result in changes in benefit spillover (Chapter IX, Fig. 12, Lines 3 and 4).

Clayton's spillover of public education benefits may be divided into two portions. The effect upon other areas from provision of Clayton education is Clayton's benefit spillout, and the effect upon Clayton from education provided in other areas is Clayton's benefit spillin. Certain benefits to Clayton residents are derived from education they provided, i.e., benefits not spilled out, and are repeated in both the spillout and spillin portion of Table 84. Clayton's flow of benefits out and in are in turn summarized in Fig. 14; the areas benefitted by Clayton's education appear on the row of the inverted L; the benefit to Clayton from education in other areas appears in the column of the L. Benefits of Clayton-provided education not spilled out are thus common to both the row and column entries.

The character and limitations of the empirical findings should be kept in mind. Only direct benefits of education to students and their mothers are estimated. Some of the major benefit assumptions on which these estimates are based are: all benefits are discounted back to the benefiting individual's place of residence at the end of the initial period, when the education was provided; the benefit estimates are based on a 5 per cent annual compound rate of interest; future and past areas of residence are projected on a probability basis on the assumption that a given community's initial rate and migration pattern is constant over time; it is also assumed that the initial period spatial tax shifting coefficients remain unchanged in the future.

Clayton spilled out to residents of other areas $833,700 or 22 per cent of the $3.8 million benefits it generated; it retained $3 million or 78 per cent of the total benefits of its education. Over 88 per cent of the benefits spilled out went to residents of the rest of the United States, while as little as 0.9 per cent were spilled out to residents of the rest of the SMSA.

Table 84

Summary of Benefits Generated and Realized by Clayton, 1959-1960, ($000)

Benefits from Clayton Education				Benefits to Clayton from General Education		
To Clayton	Spilled out to Other Areas	Total		From Clayton Education	Spilled in from Other Areas	Total
			A. Students (Chapter X)			
2,972.0	—	2,972.0	a. Income net of Taxes	2,972.0	—	2,972.0
1.0	767.0	768.0	b. Taxes	1.0	1,279.0	1,280.0
2,973.0	767.0	3,740.0	c. Total	2,973.0	1,279.0	4,252.0
			B. Mothers (Chapter XI)			
5.5	—	5.5	a. Income net of Taxes	5.5	—	5.5
0.5	66.7	67.2	b. Taxes	0.5	244.7	245.2
6.0	66.7	72.7	c. Total	6.0	244.7	250.7
2,979.0	833.7	3,812.7	C. Total Benefits	2,979.0	1,523.7	4,502.7

Fig. 14

Summary of Clayton's Total 1959-1960 Public Education Benefit Spillover by Area

($000)

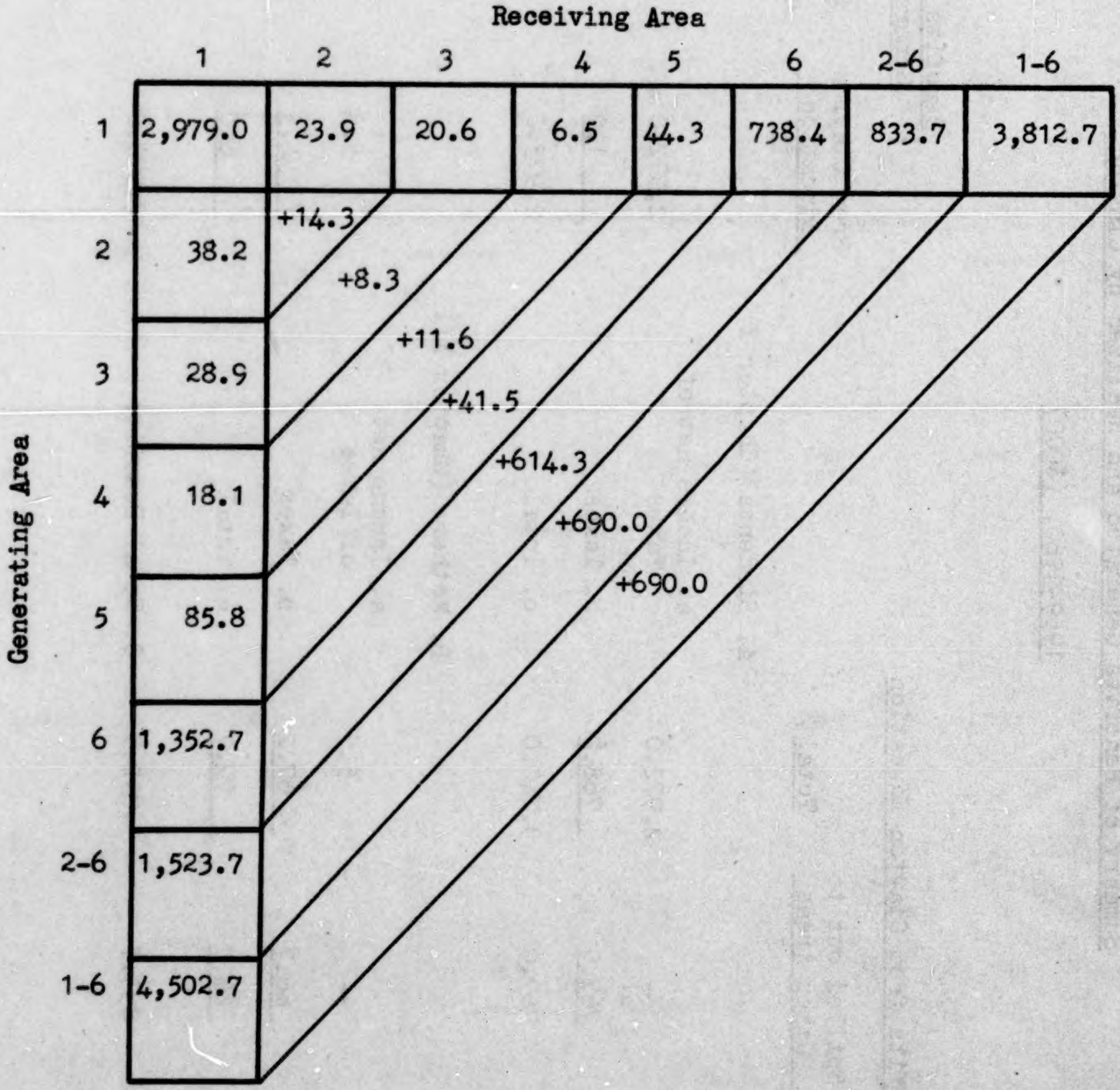
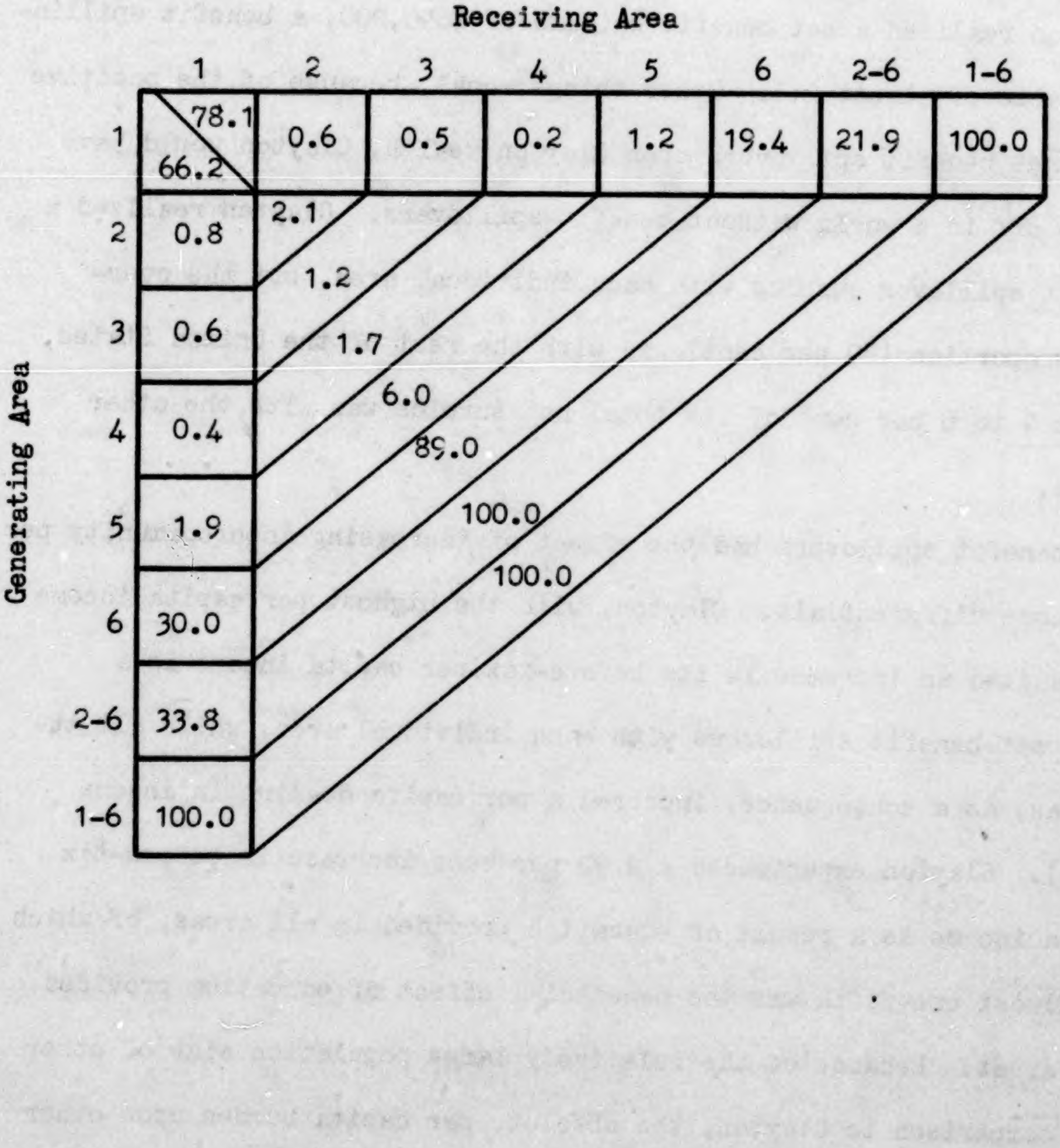


Fig. 14

Part ii

(per cent)



Clayton spilled in \$1.5 million or 34 per cent of the \$4.5 million of benefits it realized from education provided in all areas; the \$3 million benefit to Clayton from its own education amounted to 66 per cent of its total benefit from all public education. At the extremes, almost 89 per cent of all benefit spillin was from the rest of the United States and less than 1.2 per cent from the rest of the SMSA.

Clayton realized a net benefit spillin of \$690,000, a benefit spillin-spillout ratio of almost 2:1. Other things equal, because of the positive effect of net benefit spillovers upon Clayton wealth, Clayton would have been worse off in a world without benefit spillovers. Clayton realized a net benefit spillover surplus with each individual area, but the overwhelming proportion (89 per cent) was with the rest of the United States, while from 1 to 6 per cent of its total net surplus was with the other four areas.

Net benefit spillovers had the effect of increasing intercommunity per capita income differentials. Clayton, with the highest per capita income level, realized an increase in its before-tax per capita income as a result of net benefit spillovers with each individual area, while all the other areas, as a consequence, incurred a per capita decline in income (Table 85). Clayton experienced a 2.92 per cent increase in before-tax per capita income as a result of education provided in all areas, of which 0.55 or almost one-fifth was the beneficial effect of education provided by other areas. Because of the relatively large population size of other areas in comparison to Clayton, the absolute per capita burden upon other areas was slight—ranging from \$0.02, to \$0.004. The burden was slightly regressive when related to the level of before-tax community per capita income.

Table 85

Wealth Effects of Public Education Net Benefit Spillover Between Clayton and Other Areas, 1959-1960

Effect on Clayton		Net Benefit Spillover		Effect on Others	
Change in Per Capita Income*	As a Per Cent of Per Capita Income	Area	($000)	Change in Per Capita Income	As a Per Cent of Per Capita Income
+ $198.60	+ 2.37	1 (Not Spilled Out)	2,979.0	0	0
+ 0.95	+ 0.01	2	14.3	- $0.0219	-0.0004
+ 0.55	+ 0.01	3	8.3	- 0.0109	-0.0003
+ 0.77	+ 0.01	4	11.6	- 0.0198	-0.0005
+ 2.77	+ 0.03	5	41.5	- 0.0151	-0.0005
+ 40.95	+ 0.49	6	614.3	- 0.0036	-0.0001
+ 46.00	+ 0.55	2-6	690.0	- 0.0039	-0.0001
+ 244.60	+ 2.92	1-6	3,669.0		

* 1960 per capita income of persons with income by area:

Area:	1	2	3	4	5	6	2-6
$:	8,391	5,317	3,289	3,888	2,912	3,667	3,667

Components of Benefit Spillover

Prior to considering the actions a local community can take to improve its benefit spillover position, or the effect of changes in the structure of intercommunity relations upon benefit spillover, a brief review of the major components of the benefit spillover model is presented. The first stage of the benefit analysis identifies and measures the expected addition in net social output of direct beneficiaries from provision of an additional year of public education. Added net social output is the discounted present value of the expected incremental lifetime income stream of direct beneficiaries that results from the additional year of education, adjusted for differential male-female mortality and labor force participation rates.

The second stage of the analysis traces intercommunity spillover of the previously estimated total social benefits through five levels of analysis: (1) number of student and mother direct beneficiaries; (2) projected future areas of residence and rates of migration of all initial period residents; (3) total tax claim on the estimated incremental income; (4) projected tax reduction benefits, estimated by area providing education and area of benefit realization; and (5) area of residence of the tax reduction beneficiaries in the initial decision period. That portion of additional net social product that accrues to students and their mothers as net private product or disposable income does not spill over, and therefore may be traced from level 1 directly to level 5. By definition these individuals are residents of the area providing the education from which they benefit. The tax claim on income, however, spills over to residents of other communities through a reduction in their tax burdens, and is traced through each of the five levels of the analysis in stage two.

In the remainder of this chapter attention will be devoted to four of the above five levels in the second stage of the analysis. Consideration will be given to policies or changes in the economic environment which affect (1) the direct beneficiaries, (2 and 5) migration patterns, and (3) the tax claim on income. Changes in (4) fiscal interaction are excluded because community fiscal actions to improve the local district's cost spillover position are suggested earlier (Chapter VIII), and these actions would have insignificant effects upon the area's benefit spillover position. Fiscal actions that change only the local community's, or even the state's magnitude and pattern of fiscal interaction are a relatively small ingredient in the determination of the area's total benefit spillover. Tax burden benefits are heavily dependent upon the magnitude and pattern of fiscal actions throughout the rest of the United States.

Direct Beneficiaries

One policy change which has significant effects upon benefit as well as cost spillovers is lowering the average school age, for example, by allowing children to begin school one year earlier than at present. The effect of this policy would change estimated total benefits and their spillover first by increasing the duration of the student's incremental earnings benefit stream (stage I), and second by increasing the number of benefitting mothers (stage II, level 1).

Assume that the community's education production function does not change—either because many children have the capacity to begin formal school training at an earlier age, or because the subject matter currently taught could be concentrated into a shorter time span. Since schools are assumed presently to provide childcare service only to working mothers whose last child is between 6 and 11 years of age, reducing the minimum school age may be assumed to result in a 16.67 per cent increase in total net childcare benefits from Clayton-provided education, i.e., $12,119. Since Clayton spills out almost 92 per cent of its childcare benefits (Table 84), one $1,000 would be a net increase in benefits to Clayton residents, while $11,119 would spill out to residents of other areas—mainly the rest of the United States.

Lowering the average school age, however, would also mean that students would graduate from high school one year earlier, and so would add an additional year to their total lifetime income. Under the previously assumed retirement age, and wage and mortality rates, total benefits of Clayton education would increase by $26,091 (the present value of an additional $151 earned by 1,698 Clayton students who survive to age 65 and earn additional income in this 48th year of their working lives, discounted at 5 per cent compound rate). Since Clayton spilled out 20.5 per cent of its student incremental earnings benefits, a minimum of $5,349 of the additional student earnings may likewise be assumed to spill out to other areas, and $20,742 in additional net benefits accrue to Clayton residents.

The result of this change is not only clearly in the interest of the local area, since it increases local benefits by $21,961—54.5 per cent of the total increase, but it is also to the advantage of other areas which realize a net increase of $18,310 in benefits—45.5 per cent of the total benefit increase. The increase in benefits equals 1 per cent of Clayton's total benefit production (Table 84) but only one-half of 1 per cent of total benefits realized by Clayton.

Migration Patterns

A second example of circumstances that alter a community's benefit spillover, but leave cost spillover unchanged, involves a change in the rate and/or pattern of population in- or out-migration. For example, adjusting the content of the curriculum of the local community to relate it more directly to the local area's future employment opportunities might induce a reduction in the rate of out-migration of a community's youth. A reduction in population out-migration affects benefit spillover by changing both the projected future and past areas of student beneficiary residence (stage II, levels 2 and 5).

In order to trace through the effect of a reduction in Clayton's student out-migration upon benefit spillover, without full-scale simulation of the benefit model, the following assumptions and simplified version of the Clayton model were employed: (1) instead of projecting Clayton's population migration at the end of each year at a constant rate and pattern of the initial period over the entire projected lifetime of the direct beneficiaries, a once and for all 68 per cent out-migration of the initial period Clayton population was assumed. This proportion of out-migration was equal to that achieved by Clayton at the end of the 10th year in the empirical model. (2) Areas 2 through 6 were combined into a single area, so that only migration between Clayton and the rest of the world is identified. (3) The present value of student lifetime earnings for Clayton and all other areas was assumed unchanged from the initial empirical model. (4) Fiscal interaction was assumed to take place via a single combined tax rather than through separate local, state, and federal government taxes as in the initial empirical model. The spatial distribution of the burden was based on a weighted average of the initial separate tax burden distribution.

Utilizing these simplified assumptions, a benefit spillover pattern for Clayton quite similar to that of the initial empirical model was generated (Table 86, Part A).

Clayton's benefit spillover was estimated on the basis of the same simplified assumptions except that out-migration was substantially reduced (from 68 per cent to 50 per cent); no change in in-migration was assumed. The reduction in Clayton's out-migration resulted in a net increase of $281,000 in total benefits realized by Clayton public education provided by all areas (Table 86, Part B). While there was a $7,000 reduction in the benefits which Clayton residents realized from provision of their own education, benefit spillin from education provided in other areas increased by $288,000, or 6 per cent. Since total benefits from education in all areas was assumed unchanged as a result of the change in migration, the increase in Clayton's net benefit spillin was accomplished by redistributing benefits, through taxes, away from other areas, a movement away from intercommunity distributional equity.

Tax Claim on Income

A force exogenous to the local community, but nonetheless an important determinant of intercommunity spillover, is the size of total government tax claim on incremental income benefits of students and mothers (level 3 of the benefit analysis). For example, what would be the effect upon Clayton's benefit spillover if, in the future, the size of the public sector grew relative to that of the private sector so that the claim on income by government increased from 20.6 and 21.6 in other areas and Clayton, respectively, to 30.0 per cent in both areas? Change in the future period claim on income has no effect on the present period community cost spillover, since cost spillover is a function only of the initial period and not of any future period intergovernmental fiscal structure.

Table 86

Clayton's Benefit Spillovers of Student Earnings Based on Simplified Empirical Model ($000)

A.

Simplified Empirical Model, No Change

Generating Areas	1	2-6	Total
1	2,958	782	3,740
2-6	1,557		
Total	4,515		

B.

Simplified Empirical Model, Reduction in Out-Migration

	1	2-6	Total
1	2,951	789	3,740
2-6	1,845		
Total	4,796		

C.

Simplified Empirical Model, Increase in Government Tax Claim on Income

	1	2-6	Total
1	2,618	1,122	3,740
2-6	2,358		
Total	4,976		

Utilizing the identical assumptions of the simplified empirical model of Part A, but changing the tax claim on income, resulted in a substantial increase in Clayton's total benefits from education provided in all areas (Table 86, Part C). Increasing the claim on income resulted in an increase of $340,000 in Clayton's benefit spillout, which is substantial since Clayton receives very little of the tax reduction benefits from provision of its own education. However, the increased benefit spillin from education provided in other areas, $801,000, more than compensated for increased benefit spillout, so that Clayton realized a net increase in benefit spillin of $461,000. Clayton's total realized benefits increased by 10 per cent over the initial $4.5 million. Redistribution of net benefits toward Clayton again results in a movement away from equity since benefits are taken from the relatively poor areas and given to wealthy Clayton.

Summary

Clayton is thus found to generate less benefits from education than it realizes. Spillovers operate to the betterment of this already comparatively wealthy area. This favorable position for Clayton is the result of spatial tax burden benefit shifting and migration by Claytonians and others so that the tax reductions derived from others' education accrue to Clayton residents. The major portion of benefits are related to students' income as opposed to the income earned by working mothers. If policies are desired to change the existing spillovers, it would appear that reduced taxation would be most effective in reaching this goal.

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Chapter XIV

SUMMARY: INTEGRATION OF COST AND BENEFIT SPILLOVERS

The analysis of cost and benefit spillover relationships will center on three questions: (1) What are the implications of a given spillover structure for a decision-making unit (the school district)? (2) What are the implications for other areas and society as a whole of the unit's decisions? (3) What actions and policies will allow the district to change the structure of spillovers to its advantage? Previous summary chapters considered costs and benefits separately (Chapters VIII and XIII, respectively) permitting only limited conclusions. This chapter summarizes both the cost and benefit findings of the case study, their spillins and spillouts. Prior to presenting the empirical section, a general framework for the interpretation of spillovers is developed. This framework considers the implications of spillovers for local decision making and the consequences of local decisions for other communities. The empirical findings are interpreted in terms of a structure of intercommunity spillover relations assumed constant over the relevant range of expenditures; then various local actions capable of affecting spillover relations are indicated. In both instances attention is drawn to resource allocation efficiency and fiscal equity issues.

A General Framework for the Interpretation of Spillovers

Spillover findings are easily summarized in tables similar to an input-output matrix (Fig. 15). Each row of the spillover matrix represents the geographic area generating education costs and benefits, while each column indicates the area bearing the cost burdens or realizing the benefits. The dollar magnitudes in each cell are costs and benefits presented separately. Fig. 15 is a spillover matrix for n areas with a summary column indicating the total costs and benefits for each of the i rows and a summary row for each of the j columns. For area 1 the relevant data are given by row 1 and column 1; data not related to area 1, i.e., data indicating benefits and costs generated and realized by the rest of the world independent of area 1, are shown in the section of Fig. 15 below and to the right of the heavy line. In this study attention focuses upon the inverted L formed by row and column 1.

Five ratios of benefits to costs may be obtained from the data of the inverted L. Each ratio indicates the present dollar value of benefits returned per dollar of cost burden. A ratio in excess of unity represents benefits in excess of costs, i.e., a positive return.

First is the internal ratio (I) of benefits realized to costs incurred by area 1 from public education which it provides.

$$I = \frac{B_I}{C_I} = \frac{B_{11}}{C_{11}}$$

When (I) is greater than 1, the district can profit from further investment in education; when (I) is less than 1, the district bears costs from education it provides in excess of the benefits it receives. (I) equal to 1 places the district on the margin between investment in education and the next best opportunity. In this latter circumstance it will later be assumed that the district chooses investment in education only to illustrate the consequences of that decision; it will be recognized that opposite results

Fig. 15

Public Education Spillover Matrix by Areas

Realizing and Generating Costs (C) and Benefits (B)

Realizing area j Generating area i	Area 1	Areas 2, ……………………, n	Total
Area 1	B_{11}	$B_{12}, \ldots\ldots, B_{1n}$	$\sum_{j=1}^{n} B_{1j}$
	C_{11}	$C_{12}, \ldots\ldots, C_{1n}$	$\sum_{j=1}^{n} C_{1j}$
Areas 2	B_{21}	$B_{22}, \ldots\ldots, B_{2n}$	$\sum_{j=1}^{n} B_{2j}$
	C_{21}	$C_{22}, \ldots\ldots, C_{2n}$	$\sum_{j=1}^{n} C_{2j}$
⋮	⋮	⋮ ⋮	⋮
	B_{n1}	$B_{n2}, \ldots\ldots, B_{nn}$	$\sum_{j=1}^{n} B_{nj}$
n	C_{n1}	$C_{n2}, \ldots\ldots, C_{nn}$	$\sum_{j=1}^{n} C_{nj}$
Total	$\sum_{i=1}^{n} B_{i1}$	$\sum_{i=1}^{n} B_{i2}, \ldots\ldots, \sum_{i=1}^{n} B_{in}$	$\sum_{i=1}^{n} \sum_{j=1}^{n} B_{ij}$
	$\sum_{i=1}^{n} C_{i1}$	$\sum_{i=1}^{n} C_{i2}, \ldots\ldots, \sum_{i=1}^{n} C_{in}$	$\sum_{i=1}^{n} \sum_{j=1}^{n} C_{ij}$

would obtain if the assumption were reversed.

The second ratio obtained from the row segment of the inverted L may be termed the spillout ratio (O). This ratio indicates the benefits returned to residents of other areas (j=2, ... , n) per dollar of cost burden borne by them for education by the district.

$$O = \frac{B_O}{C_O} = \frac{B_{12} + B_{13} + \ldots B_{1n}}{C_{12} + C_{13} + \ldots C_{1n}}$$

When (O) is less than 1, other areas bear costs in excess of the benefits they receive from education provided by school district 1. When (O) is greater than 1, other areas gain from education provided by area 1. When (O) is equal to 1, the costs borne equal the benefits realized.

The effect upon society at large, upon the district providing the education, and upon other districts affected by that education decision, is indicated by the production ratio (P), i.e, the benefits to all areas per dollar of costs incurred in the provision of education by area 1.

$$P = \frac{B_I + B_O}{C_I + C_O} = \frac{\sum_{j=1}^{n} B_{1j}}{\sum_{j=1}^{n} C_{1j}}$$

In short, the row data indicate the returns to the area providing education, to areas affected by its decision, and to both groups which constitute society at large.

A school district can also experience benefit and cost spillins generated by education provided in other areas. These magnitudes are found in the column segment of the inverted L. The spillin ratio (N) indicates the benefits realized by area 1 per dollar of cost burden it realizes as a result of education in other areas.

$$N = \frac{B_N}{C_N} = \frac{B_{21} + B_{31} + \ldots . B_{n1}}{C_{21} + C_{31} + \ldots . C_{n1}}$$

When (N) is greater than 1, the district realizes an excess of benefit spillins over cost spillins; it receives net gains as a result of education provided in other areas. When (N) is less than 1, the district incurs a decrease in wealth—the cost burden is in excess of the increase in benefits it realizes from education provided elsewhere.

The consequences for a school district of education it and other areas provide are indicated by the gross ratio (G)—the ratio of total benefits it realizes from education provided in all areas to the total costs it bears.

$$G = \frac{B_I + B_N}{C_I + C_N} = \frac{\sum_{i=1}^{n} B_{i1}}{\sum_{i=1}^{n} C_{i1}}$$

When (G) is greater than 1, the additions to the district's wealth exceed the reductions from it; the area profits. When (G) is less than 1, the reductions exceed the additions and the area loses.

Consequences of a District's Investment Decisions

The significance of benefit and cost spillovers, as viewed by a school district, is best analyzed by considering the effects spillovers can have upon the community's decision to increase investment in its own education. If the community assumes a given structure of forces generating benefit and cost spillover, the spatial pattern of benefit and cost spillovers are likewise assumed constant over the relevant expenditure range. The spatial distribution of costs is based on estimated average tax shifting patterns, which is assumed to be the spatial shifting of a marginal tax increase. It is assumed that an x per cent increase in education investment is accomplished by an identical x per cent increase in all components of cost and benefit. Costs are assumed financed from revenue sources in the same proportion as currently utilized by the district. The additional education investment is presumed not to change the spatial pattern of benefit spillover by effecting changes in population migration or fiscal interaction. Homogeneity of educational inputs is assumed; their proportional expansion, i.e., marginal expenditures on all inputs—salaries, equipment, supplies—generates equal marginal benefits. Further, it is assumed that there is no budget constraint on the local area, from the cost spillins (C_n). Finally, it is assumed that the community utilizes the most efficient education production function available.

The internal ratio (I) can then serve as an indicator to the school district of the desirability of further investment in education. If the internal ratio (I) is greater than 1, and this is known to the district, it should further invest in its schools. If (I) is less than 1, the district would be reluctant to invest further in its schools, since this step would tend to reduce its wealth. Clearly, either decision by the district has a consequence for other districts and for society at large. Table 87 summarizes the possible alternative patterns of the (I), (O), and (P) ratios of a district, which indicate whether or not the district will invest under each configuration of ratios in its attempts to maximize total district wealth and the distributional effects of the decision.

Table 87

Alternative Internal (I), Spillout (O), and Production (P) Ratios, With Their Effect upon a Local Community's Incremental Investment Decision and the Distributional Effects upon Other Areas

	Ratios Relative to Unity				
Case	Internal	Spill Out	Production	Does Local Community Make Marginal Investment?	Distributional Effects
1	>	>	>	Yes	all areas gain
2	>	=	>	Yes	others on the margins, local area gains
3	=	>	>	Yes	others gain, local on margin
4	=	=	=	Yes	everyone on margin
5	>	<	>	Yes	society gains, local gains outweigh others' losses
6	>	<	=	Yes	society on margin, local gains equal other's losses
7	>	<	<	Yes	society loses, other's losses outweigh local gains
8	=	<	<	Yes	society loses, other's losses outweigh local gains
9	<	>	>	No	society loses, other's gains outweigh local losses
10	<	>	=	No	society on margin, other's gains equal local losses
11	<	>	<	No	society loses, local losses outweigh other's gains
12	<	=	<	No	local losses, others on margin, society loses
13	<	<	<	No	all areas lose

The analysis only considers alternative patterns in which the ratios are either less than, equal to, or greater than unity.

In the first example of Table 87, the internal ratio is greater than 1, and the local area should find it desirable to make additional education investments. Since cost in this analysis includes foregone interest on investments of equal risk, the appropriate criterion is for the local community to keep on investing as long as (I) is greater than 1. The spillout ratio (O) of Case 1 is also greater than 1, which means that the production ratio (P) is greater than 1. In this happy situation, both residents and non-residents gain from additional local investment, and spillovers do not generate conflict between the two groups.

The local community finds additional investment in its schools desirable in Cases 1 through 8 and therefore tends to invest. However, only in Cases 1 through 4 do other communities gain through spillovers from this investment. In these cases, there is no conflict between local and other areas' interests, and society is clearly better off or on the margin if the district's (P) ratio is exactly equal to 1. In Cases 5 and 6, while the local internal ratio (I) and the production ratio (P) are greater than or equal to 1, residents in other areas lose. However, since the gains to local residents from the expenditure outweigh the losses to others, society could gain; gainers could compensate losers and still be better off. In Cases 7 and 8, the local community finds it profitable to invest; but the losses of other areas are sufficiently large that society as a whole is worse off since the gainers are unable to compensate other areas for their spillover losses and still be better off themselves.

In Cases 9 through 13, the internal ratio (I) is less than 1 and the local community appears to have little incentive for incremental investments.

The investment might be socially desirable, however, since other areas might gain more than the local community loses. With appropriate compensation of losers by gainers, everyone could be better off in Cases 9 and 10. Other areas would also tend to encourage the given local investment in Cases 11 and 12, but the investment is socially undesirable, since the gains of other areas are insufficient to compensate the local area for its losses. Finally, in Case 13, the investment is clearly undesirable since everybody tends to lose.

A local community's investment decision not only affects the overall efficiency of resource allocation from society's point of view, but it also has an effect upon equity. Cases 7 through 10 are examples of benefit spillover patterns in which the local community's investment interest is in direct conflict with the general welfare gained by society from efficient resource utilization. In Case 7, for example, the local community gains by investing since (I) is greater than 1, but society at large loses because (P) is less than 1. On the other hand, while the local community would lose by investing in Case 9, society would tend to gain. In such cases appropriate tax penalties or transfer subsidies could be instituted to make local investment decisions more consistent with the general welfare.

The effect of the local community's investment decision upon distributional equity is perhaps most clearly seen by viewing the local investment from the point of view of other areas. In Cases 3, and 9 through 12, other areas stand to gain relative to the local area from the latter's investment, i.e., the spillout ratio (O) is greater than the internal ratio (I). In Cases 2, and 5 through 8, on the other hand, others stand to lose relative to the local area since (O) is less than (I). In Case 4, the ratios are equal and neither area gains an added advantage over the other. In the preceding cases, except for Case 4, it is clear whether one area stands to gain relative to the other because (I) and (O) are either greater than, equal to, or less than 1, and are not equal to each other. In these cases, except 2 through 4, one area gains while the other loses.

The redistributional effects of Cases 1 and 13 are somewhat more complex. In these cases, (I), (O), and (P) are all either greater or less than 1. For example, if in Case 1, (I) = 2.5, (O) = 1.5, and (P) = 2, i.e., all are greater than 1, local residents gain more per dollar of cost burden than residents of other areas. Additional local education expenditure is "better" for local residents, in the sense that they gain at a faster rate than residents of other areas. If (I) equals (O), both benefit equally, while if (I) is less than (O), local investment is "better" for others than for the local community. Likewise, even though (I), (O), and (P) are all less than 1 in Case 13, if (I) is greater than (O), other areas are "worse off" than local residents in the sense that they get poorer at a faster rate as a result of additional local investment. If (I) equals (O), both stand to lose at an equal rate, while if (I) is less than (O), local residents get poorer at a faster rate than others.

Local Consequences of General Education Decisions

A given community's welfare is enhanced if its public schools provide internal benefits in excess of costs, $(B_I - C_I)$. However, the welfare of the community is also dependent upon the difference between benefit and cost spillins from education provided in all other areas, $(B_S - C_S)$. Therefore, the community's welfare from provision of public education in all areas is the difference between gross benefits and costs, $(B_I + B_N - C_I - C_N) = (B_G - C_G)$. Assuming a given intercommunity spillover pattern, and that cost spillin is no constraint upon the level of local expenditure, communities may be assumed to attempt to maximize their gross spillover ratio (G), in order to attain the largest increase in total net wealth $(B_G - C_G)$. (G) is a composite of (I) and (N), i.e., $G = \frac{B_I + B_N}{C_I + C_N}$, and the (I) and (N) ratios imply different actions by the local community to maximize its welfare from the provision of public education in all areas. Table 88 summarizes the effects of additional expenditure for local and other areas' public education upon local and other areas' wealth for alternative (I), (N), (G) ratio relations. It identifies, in each case, whether additional local expenditure is desirable as a means of increasing local welfare.

In Cases 1 through 8, an increase in local public education expenditure either increases or results in no change in total community wealth (Table 88, column 6). If the community's internal ratio is greater than or equal to 1, additional expenditure on local public education will either result in an increase or no change in community wealth, respectively. In Case 1, the local community finds itself in the pleasant situation where an increase in either its own or in others' public education expenditures results in an increase in local community wealth. However, in this case, (G) will rise from increased local expenditure only if (I) is greater than (N); (G) will rise from others' increased expenditures only if (I) is less than (N). (G) remains unchanged from either additional local or foreign expenditure if (I) equals (N). However, total local wealth increases from any additional expenditure if (I) and (N) are greater than 1, irrespective of whether (I) is greater or less than (N).

Table 88

The Effects of Additional Local and Other Areas' Public Education Expenditures upon Local Wealth for Alternative Ratio Relations

	(1) Ratios Relative to Unity	(2)	(3)	(4)	(5) Effect of Local Expenditures On:	(6)	(7) Effect of Others' Expenditure On:	(8)
Case	Internal	SpillIN	Gross	Additional Local Expenditure	G	Wealth	G	Wealth
1	>	>	>	Yes	*	+	*	+
2	>	=	>	Yes	+	+	-	o
3	>	<	>	Yes	+	+	-	-
4	>	<	=	Yes	+	+	-	-
5	>	<	<	Yes	+	+	-	-
6	=	>	>	Yes	-	o	+	+
7	=	=	=	Yes	o	o	o	o
8	=	<	<	Yes	+	o	-	-
9	<	>	>	No	-	-	+	+
10	<	>	=	No	-	-	+	+
11	<	>	<	No	-	-	+	+
12	<	=	<	No	-	-	+	o
13	<	<	<	No	**	-	**	-
* 1	(I, N, G) >1, and							
1a	I > N			Yes	+	+	-	+
b	I = N			Yes	o	+	o	+
c	I < N			Yes	-	+	+	+
** 13	(I, N, G) <1, and							
13a	I > N			No	+	-	-	-
b	I = N			No	o	-	o	-
c	I < N			No	-	-	+	-

Where + indicates a positive change
- indicates a negative change
o indicates no change

In Case 2, local community wealth is increased from local education expenditure, while additional expenditure elsewhere has no effect upon local wealth. With the (I) and (N) ratios of cases 3, 4 and 5, local welfare is increased by additional local expenditure, but declines with others' expenditure. In such a situation, the local area finds it profitable to discourage additional expenditure on education in other areas.

In Case 6, additional local expenditure has no effect upon improving community welfare, whereas additional expenditure elsewhere increases local welfare. Case 7 is one in which additional expenditure in any area has no effect upon local wealth. In Case 8, additional local expenditure raises (G) without increasing wealth because (I) is just equal to 1; additional expenditure elsewhere reduces local wealth.

In Cases 9 through 13, the community does not spend more on local education because (I) is less than 1; added expenditure results in a deterioration in local welfare. In Cases 9 through 11, however, because (N) is greater than 1, additional expenditure elsewhere increases (G) and local wealth. In Case 12, additional expenditure in other areas increases the local gross ratio without increasing welfare. Finally, in Case 13, local welfare declines from either additional local or others' expenditures. This happens irrespective of the fact that (G) increases from local expenditure if (I) is greater than (N), and from foreign expenditure if (I) is less than (N).

Thus, the local community finds it more efficient to increase the level of local welfare by attempting to increase public education expenditure in other areas, rather than to increase local education expenditure under configurations of (I), (N), and (G), represented in Cases 6, and 9 through 12.

A more equitable distribution of per capita income may be achieved under any of the above configurations of (I), (N), and (G), depending upon which areas are relatively poor or wealthy. If other areas are poor relative to the local community, those configurations of (I), (N), and (G) that more efficiently increase the level of local welfare by increased public education expenditure in other areas move toward equity if the internal ratio of other areas is greater than the spillin ratio of the local community. However, under ratio configurations in which the local community finds it more efficient to increase local welfare by increased local expenditure, a movement away from distributional equity results if its (I) is greater than (G). Resource allocation efficiency, on the other hand, is maximised by increasing expenditure only in areas with high production ratios (P). Even though (P) is higher in the wealthy local community, a more equitable distribution of income could be accomplished by redistributional tax and fiscal policy.

The analysis assumes that cost spillin is not a depressant on the level of local expenditure. Given sufficient information on cost spillin, a testable hypothesis is that the wealth effect of (C_E) reduces expenditure on local education, especially once (C_E) exceeds a threshold percentage of local expenditure. Benefit spillin, on the contrary, may not have an offsetting up-lifting effect on local expenditure because the school district is most likely unable to borrow in the capital market on the expected benefit spillin which accrues to local residents in several future locations. Under these conditions, cost spillin would partially offset the positive motivating effect on local expenditures of cost spillout.

The Net Relations of Spillovers

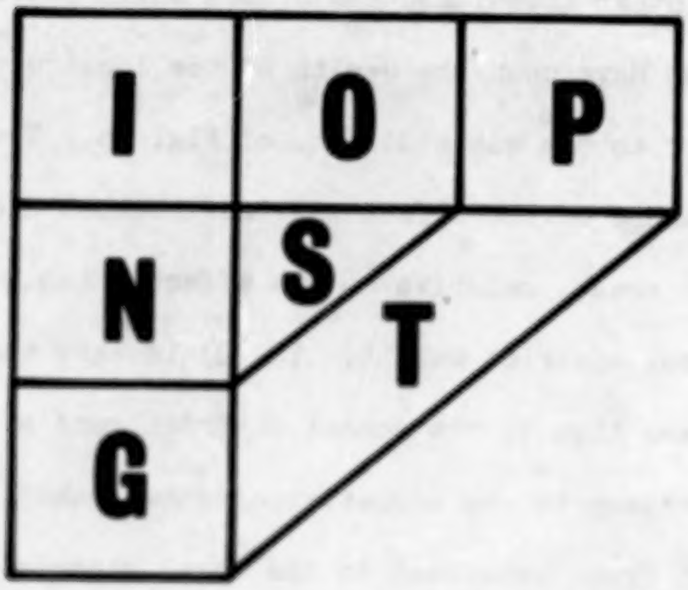
The net effect which additional local expenditure has upon its own wealth and that of other areas, and the effect which additional expenditures in other areas have upon the wealth of the local community may be analyzed in relation to the ratio diamond of Fig. 16. The ratio (S) spillover is a measure of the effect the local school district has upon the wealth of other areas, relative to the effect which actions of other areas have upon local district wealth. If (O) is less than (N), and therefore (S) is less than 1, the school district gets a higher rate of return on its investment in the education of other school districts than other districts get from investment in the local district. With the given structure of intercommunity spillover, the effect of additional local expenditure is less favorable upon the wealth of other areas than additional expenditure in other areas is upon the school district. The school district gains relative to others. The magnitude of the spillover effect equals the difference between $(B_O - C_O)$ and $(B_N - C_N)$.

A second comparison relates to the effect which the local district's expenditure action has upon society's wealth relative to the effect which education decisions of society have upon wealth of the local school district, i.e., the ratio of relative consequences (T). If (P) is less than (G), and therefore (T) is less than 1, given the structural spillover relations and the relative levels of expenditure by the areas involved, the local school district gains through the existence of spillovers, i.e., $S = \frac{O}{N} > 1$, the unfavorable ratios might again be offset by the relative expenditure levels of other areas so that the school district is better off than with no spillover.

The welfare of a community is thus dependent upon the net effect of

Fig. 16

The Ratio Diamond



where,

$I = \frac{B_I}{C_I}$, effect of the local district's expenditure action upon itself.

$O = \frac{B_O}{C_O}$, effect of the local district's expenditure action upon others.

$P = \frac{B_I + B_O}{C_I + C_O} = \frac{B_P}{C_P}$, effect of the local district's expenditure action upon society.

$N = \frac{B_N}{C_N}$, effect of other district's expenditure action upon the local district.

$G = \frac{B_I + B_N}{C_I + C_N} = \frac{B_G}{C_G}$, effect of other and local district's expenditure action.

$S = \frac{O}{N}$, change in other areas' wealth relative to the local school district's wealth due to each other's expenditure actions.

$T = \frac{P}{G}$, effect of the local district's expenditure action upon society's wealth relative to the effect of all education decisions upon the wealth of the school district.

its own actions as well as upon the actions of others. Under the assumption of a fixed spillover structure, the ratios (I), (O), (P), (N), and (S) are constant to the local community. The latter, however, can effect changes in (G), and therefore (T). If $(I > N)$, the local community can increase (G) through additional local expenditure and therefore increase community wealth.

The equity consequences of spillovers depend upon the criteria of welfare. If a tendency toward an equal distribution of per capita wealth is sought, spillovers which are unfavorable to the relatively poor will be considered contrary to equity. When only two of several areas are considered, the distributive consequences of spillovers between them may be stated. For example, if areas 1 and 3 are of equal population with area 1 being the wealthier of the two, spillovers will work toward equity when the net benefits spilled out by 1 to 3 exceed the net benefits spilled into 1 by 3, i.e., $(B_{13} - C_{13})$ is greater than $(B_{31} - C_{31})$. A complete analysis of the redistributive wealth effects, however, requires the consequences of decisions in all areas be considered. It is possible for the relations between all other areas and areas 1 and 3 respectively to more than offset the inequitable spillover between 1 and 3.

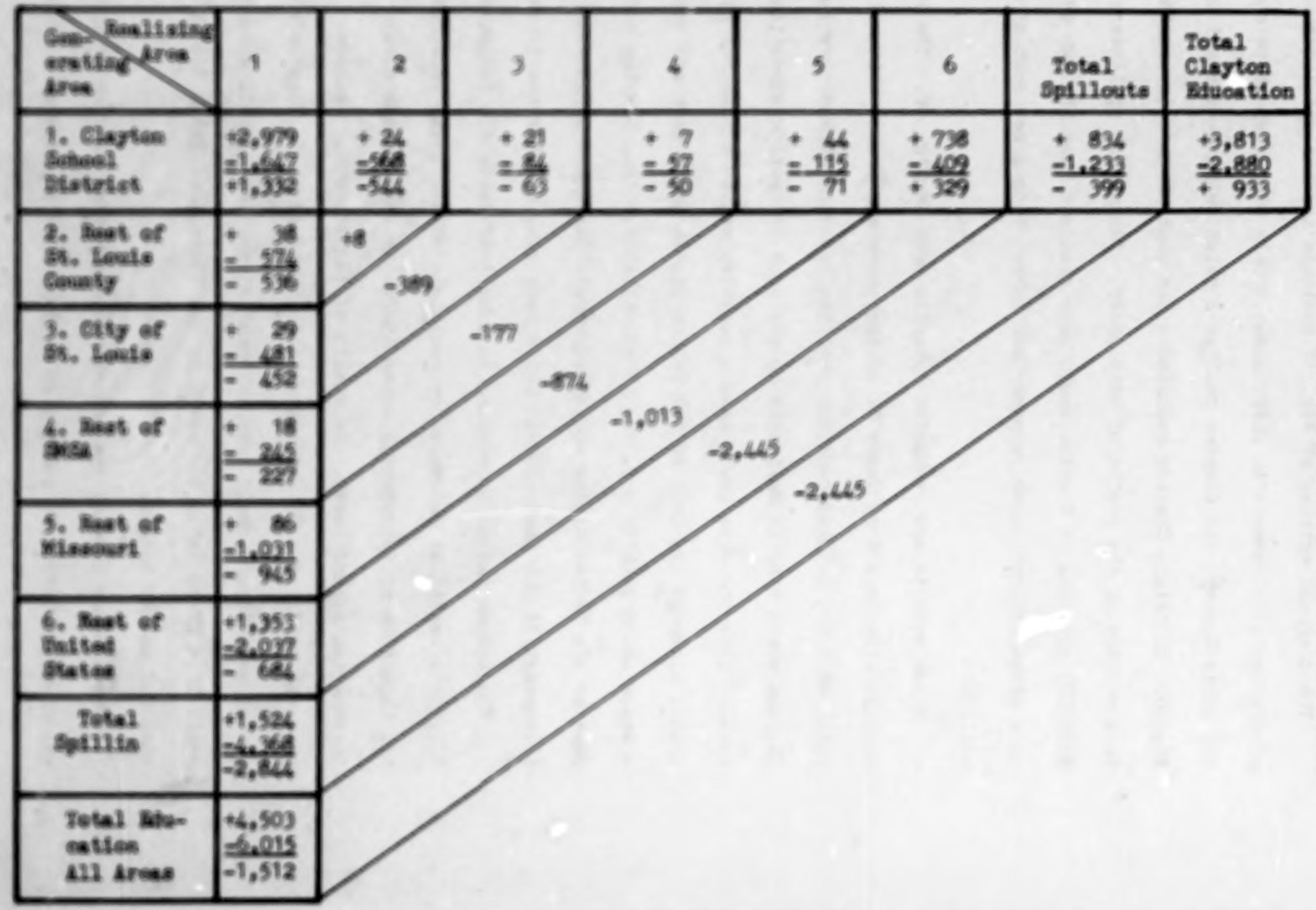
In the following section the framework developed above will be applied to the case study. First the implications of the findings will be discussed. Then attention will turn to the possible actions which may improve a school district's wealth position.

Summary of Spillovers in the Case Study

At this point it might be well to restate some of the key assumptions upon which the case study results are based. Only resource opportunity

Fig. 17

Benefits and Costs of Public Education Generated and Realized By Clayton, Missouri, 1959-1960, by Area ($000)



Generating Area \ Realising Area	1	2	3	4	5	6	Total Spillouts	Total Clayton Education
1. Clayton School District	+2,979 -1,647 +1,332	+ 24 -568 -544	+ 21 - 84 - 63	+ 7 - 57 - 50	+ 44 - 115 - 71	+ 738 - 409 + 329	+ 834 -1,233 - 399	+3,813 -2,880 + 933
2. Rest of St. Louis County	+ 38 - 574 - 536	+8						
3. City of St. Louis	+ 29 - 481 - 452		-389					
4. Rest of SMSA	+ 18 - 245 - 227			-177				
5. Rest of Missouri	+ 86 -1,031 - 945				-874			
6. Rest of United States	+1,353 -2,037 - 684					-1,013		
Total Spillin	+1,524 -4,368 -2,844						-2,445	
Total Education All Areas	+4,503 -6,015 -1,512							-2,445

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The diagonal entries of Fig. 17 indicate the net spillover position of Clayton with respect to other areas. Only with respect to one area, St. Louis County, did Clayton realize a relative gain—a small one of $8,000. In total, Clayton realized a net cost or loss in wealth of $2.4 million as the result of spillovers. Because of spillovers the $933,000 net benefit Clayton would have realized from its own education in a closed migrationless economy was turned into a net cost of $1.5 million.

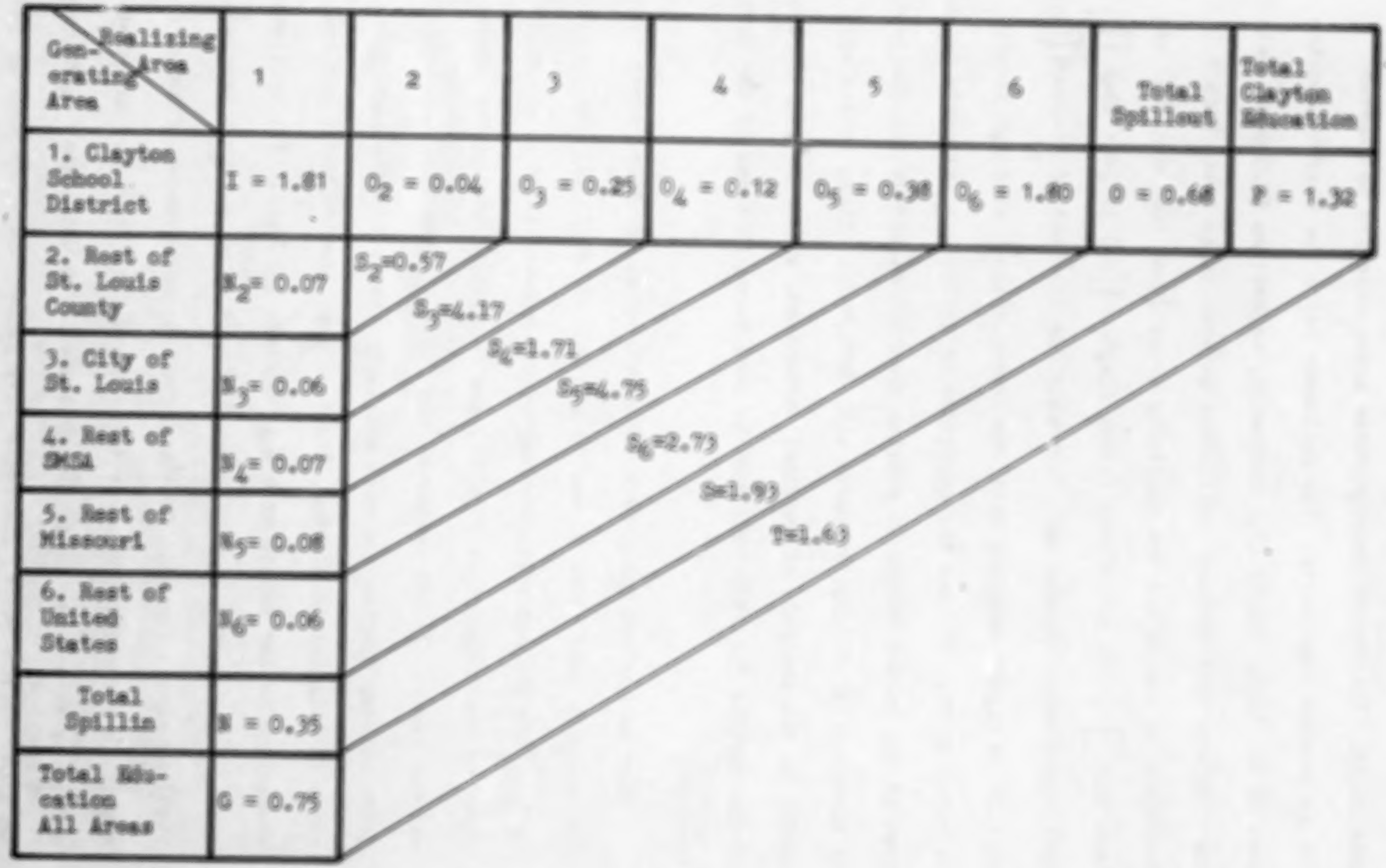
These results are presented in ratio form in Fig. 18. The row entries conform with Case 5 of Table 87 of the above analysis. With an internal ratio of 1.81, assumed constant over the relevant expenditure range, Clayton would find it desirable to increase its public education expenditures. This increase would have a negative wealth effect for other areas, although the rest of the United States would gain and society as a whole would gain (P = 1.32). Theoretically, then, Clayton and the rest of the United States could compensate Clayton's neighboring areas (2 through 5) for their losses while retaining net increments in wealth.

The column ratios correspond to Case 5 of Table 88, indicating that Clayton's wealth is decreased by decisions of all areas combined. When the magnitude of incremental expenditures in other areas equals Clayton's incremental expenditures, the wealth of Clayton would decline. Given the internal ratio of 1.81 and the spillin ratio of 0.35, Clayton's incremental expenditure would have to equal 45 per cent of all areas' increments if a gross ratio (G) equal to one (Case 4 of Table 88) is to be obtained on the margin.

These ratio results restate the findings that Clayton's education was more beneficial to society as a whole than all areas' education was

Fig. 18

Benefit-Cost and Relative Spillover Ratios



Realising Area / Generating Area	1	2	3	4	5	6	Total Spillout	Total Clayton Education
1. Clayton School District	I = 1.81	O_2 = 0.04	O_3 = 0.25	O_4 = 0.12	O_5 = 0.38	O_6 = 1.80	O = 0.68	P = 1.32
2. Rest of St. Louis County	N_2= 0.07							
3. City of St. Louis	N_3= 0.06							
4. Rest of SMSA	N_4= 0.07							
5. Rest of Missouri	N_5= 0.08							
6. Rest of United States	N_6= 0.06							
Total Spillin	N = 0.35							
Total Education All Areas	G = 0.75							

S_2=0.57

S_3=4.17

S_4=1.71

S_5=4.75

S_6=2.73

S=1.93

T=1.63

to Clayton—the ratio of total relative consequences (T) is greater than unity. Spillovers favored other areas relative to Clayton—(S) is greater than unity. The spillover ratio for Clayton and the rest of St. Louis County (S_2) indicates, as did the $7,000 net gain for Clayton, that although spillovers between these areas result in decreases in wealth for the realizing areas [both (C_2) and (R_2) are less than 1], the net effect favors Clayton [(S_2) is less than 1]. Spillovers rates operate most favorably for the rest of Missouri [(S_3) at 4.75 is higher than any other spillover ratio] although it will be noted in Fig. 17 that the magnitude of spillovers favorable to the rest of the United States is greater than the magnitude for the rest of Missouri ($1,013,000 compared with $874,000). Thus, ratios will be useful in the analysis of marginal variations, while the significance of the results for 1959-1960 must be considered in terms of the magnitudes involved.

What do the net spillovers between Clayton and other areas signify? One commonly used index of wealth and well-being is per capita income. In Table 89 the net spillover magnitudes between Clayton and other areas, shown on the diagonal in Fig. 17, are related to per capita income of the various areas. In the center of the table are the magnitudes of spillovers between Clayton and each area. On the left these magnitudes are shown in relation to Clayton, first on a per capita basis and then as a percentage of per capita income in Clayton for 1959. All spillovers decrease per capita wealth in Clayton by $163 or nearly 2 per cent of 1959 per capita income. To the right the consequences of these spillovers are shown for the areas interacting with Clayton. As noted above, all areas except St. Louis County gained from spillovers with Clayton. On a per capita basis, St. Louis City gained most, the average person

Table 89

Relation of Clayton Net Spillovers to 1969 Per Capita Income By Area (in dollars and percentages)

In relation to Clayton		Net Spillovers with	In relation to other areas	
Dollars per capita	Per Cent of per capita income		Dollars per capita	Per Cent of per capita income
+ 0.53	+0.0063	2. Rest of St. Louis County—$8,000	- 0.012	-0.00022
- 25.93	-0.3090	3. City of St. Louis $309,000	+ 0.510	+0.0155
- 11.80	-0.1406	4. Rest of SMSA $177,000	+ 0.303	+0.00779
- 58.27	-0.6944	5. Rest of Missouri $874,000	+ 0.318	+0.01092
- 67.53	-0.8048	6. Rest of United States—$1,013,000	+ 0.005	+0.00014
-163.00	-1.9426	Total Net Spillovers $2,445,000	+ 0.014	+0.00038

Per capita income by area

Clayton School District	$ 8,391
Rest of St. Louis County	5,317
City of St. Louis	3,289
Rest of SMSA	3,888
Rest of Missouri	2,912
Rest of United States	3,667

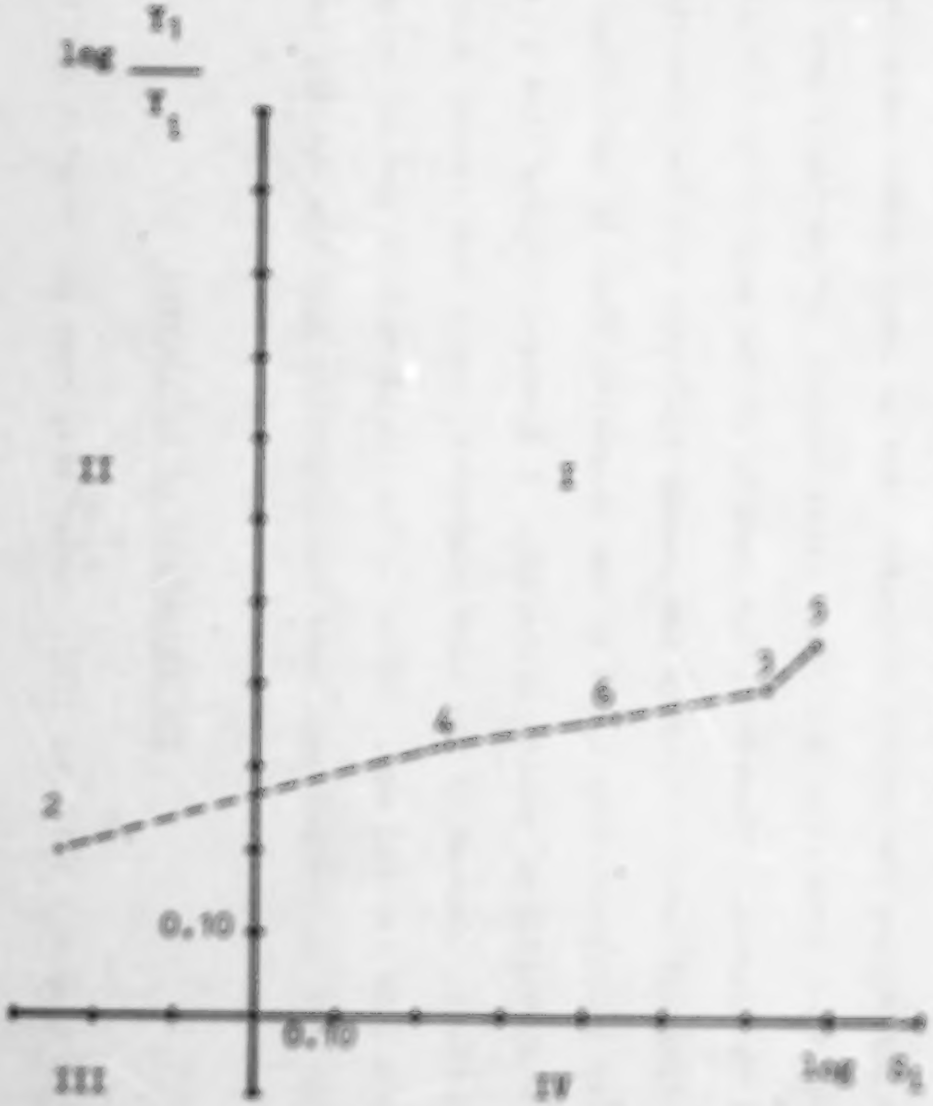
receiving a net benefit of $.51. Also on the basis of increase in per capita income this area gained most, but less than two-hundredth of 1 per cent.

Because Clayton is such a small part of the entire nation, it is difficult to assess the equity implications of these findings. However, it is possible to discover whether spillover relations between Clayton and other areas are operating in the direction of equity. If per capita income is selected as the index of wealth, and the criterion of equity in relation to intercommunity spillovers is that spillovers should benefit the poorer areas relative to the wealthier, then the greater the income of one area to that of another, the greater the spillover ratio (S) for the wealthier should be. It will be recalled that (S) is the ratio of the spillout ratio (benefits spilled out over costs spilled out) to the spillin ratio (benefits spilled in over costs spilled in). When (S) is greater than 1, the return per dollar of cost borne by other areas from education in the initial area exceeds the return per dollar of cost borne by that area from education in other areas. This means that other areas are obtaining benefits from the initial area at a greater rate than the initial area is gaining from them. In short, an area loses relative to others when its (S) ratio is greater than 1.

Consider Fig. 19. On the vertical axis, the per capita income of the initial area (Clayton in this case) is measured relative to per capita income in each of the other areas (i). The wealthier Clayton is compared to others, the higher the measure on this scale. On the horizontal axis is the (S) ratio with higher values of (S) toward the right. For a point in quadrant I, Clayton is the wealthier of the two areas under consideration and spillovers are favorable for Clayton: spillovers move in

Fig. 19

Spillover Ratios (S) and Relative Per Capita Income



	Clayton's per capita income relative to per capita income in other areas $\log \frac{Y_1}{Y_i}$	Spillover ratios $\log S_i$
2. Rest of St. Louis County	0.20	-0.24
3. City of St. Louis	0.41	0.62
4. Rest of SMSA	0.33	0.23
5. Rest of Missouri	0.46	0.68
6. Rest of United States	0.36	0.44

Logarithms are used on both axes so that a factor of 2 in either direction is given equal graphic distance.

the direction of distributional equity. In quadrant II, Clayton residents are again the wealthier, but spillovers run in their favor and this is inequitable. In the third quadrant Claytonians are relatively poorer and spillovers are favorable to them: an equitable arrangement. Finally, in the fourth quadrant spillovers are unfavorable to Clayton and Clayton residents are relatively poor: spillovers work contrary to distributional equity. Thus, points in quadrants I and III represent equitable spillover relations between Clayton (any initial area) and another area; points in quadrants II and IV are inequitable.

Fig. 19 shows, Clayton's spillover relations with four of the five other areas are working in the direction of equity. Spillovers are favorable to Clayton only with respect to the rest of St. Louis County. All areas are relatively poorer than Clayton. The only inequitable relationship is between Clayton and the rest of St. Louis County. The line connecting the points indicates that as areas become relatively poorer to Clayton, the spillover ratio becomes increasingly less favorable to Clayton. Therefore, the results of the case study indicate that existing spillover relations are mainly equitable and the direction of equity adjustment (the slope of the suggested line) is consistent with the distributional equity criterion. A downward sloping line of equity adjustment, located in the same quadrants, would work toward equity in a much more limited way. Poorer areas would receive smaller rather than larger per capita net spillover contributions from the wealthy areas.

The Structure of Spillovers

In Chapters VIII and XIII, summarizing cost and benefit spillovers respectively, we analyzed some of the consequences of changes in the structure of forces generating spatial spillovers. The components discussed in those chapters were:

Cost Components	Benefit Components
Nature of the input	Incremental income
	Migration
	Tax claim on income
Financing unit	Taxing unit
Revenue source	Revenue source
Incidence determinants	Incidence determinants
	Migration

This listing indicates the interrelation of the cost and benefit parts of the foregoing analysis. The spatial spillover patterns of different government units levying taxes, their sources of revenue, and the incidence patterns of these sources require determination for both cost and benefit spillovers. It should be noted that the revenue sources on the benefit side are more inclusive than those considered on the cost side. On the one hand, the increased income of mothers or students is subject to taxation by all levels of government for all governmental functions. On the other hand, the taxation employed in the support of education represents only a portion of local and state taxes. Thus, changes introduced in the financing of education may have significant results with respect to costs and their spillovers and yet have little influence on the spatial distribution of tax reduction benefits. It is clear that changes in the tax components of costs affect tax component changes in the benefit analysis, but preliminary investigations in connection with Chapter XIII indicated negligible numerical benefit spillover results in the relevant range of tax variation.

A second interrelationship of the model is of the taxation and migration components of benefits. Major population shifts would lead to changes in the tax rates of individual areas and changes in incidence patterns. Although there would be no effect upon the cost side, the benefit distribution would be altered. These considerations are restated at this point to direct the reader's attention not so much to the complexities of the model but to the tentative quality attached to the findings when changes in the structure are introduced.

Thus far the analysis has assumed that the local community takes the structure of intercommunity forces generating public education cost and benefit spillovers as fixed within the relevant marginal expenditure range. The analysis has been directed toward answering the questions: What effects would spillovers have upon a community's incremental public education expenditure? What are the effects of spillovers upon intercommunity distribution of wealth?

Over a longer planning period, another question arises: What actions can the local community take in order to improve its spillover position? The local district can improve its internal and gross ratios, not only by raising and lowering the level of local expenditure, but also by changing the structural pattern which affects the rate at which the benefits and costs of public education spillover local school district boundaries. The effect of structural changes in cost and benefit spillovers upon resource efficiency and distributional equity must again be considered. The direction of change in spillover ratios as a result of local community structural change can often be inferred; a comprehensive, detailed analysis of the structural effect upon each study area must await full scale simulation of the model.

The structure of a community's spillover relations can be changed either by taking direct local action, or by indirect influence of decision-makers in other communities to take actions that favorably affect local spillovers. Actions effecting a change in spillovers may be initiated by the local school board, through the superintendent, by the coterminous municipality, through the mayor, or by the individual school district-municipality resident-voter. The superintendent, mayor, or individual voter can directly take actions to change the spillover structure of the local community, but they can only attempt to influence policy-makers and voters of other areas to take local actions that have favorable spillover effects for the given local area.

Lowering the School Entry Age

In Chapters VIII and XIII a specific institutional change was considered: lowering the school entry age from six to five. This is a policy change within the authority of the school district; it is a step which may be taken unilaterally without concern for the reactions of neighboring communities or economic interest groups within the district. Except for state prohibition of such a step, the school board is constrained only by the education philosophy of parents in the district, possible staff and plant limitations, and the ability of children to learn the required material at younger ages. This in turn may prove to be a function of the ability of the teaching staff. We will credit the existing faculty with the necessary pedagogical virtuosity and assume that direct per pupil operating costs will not rise.

Chapter VIII demonstrated that Clayton's cost of education would fall by $306,000 if this policy change were instituted. This reduction was related to foregone earnings of Clayton residents. Chapter XIII indicated that the increase in total benefits of this change in the entry age would be $38,000, of which $22,000 would be realized by Clayton, and $16,000 by residents of other areas. Clayton's internal net benefits would rise by $228,000 from $1,232,000 to $1,460,000, or 25 per cent. Net social benefits would rise by $344,000 or 37 per cent. The existence of spillouts allows society to benefit from Clayton's actions. Spillins do not change; thus the net cost to Clayton of education provided in all areas is reduced from $1.3 million to $1.1 million, or 22 per cent. The change in spillouts without a change in spillins leads to an increase in the net cost spillover borne by Clayton. The consequence of lowering the school entry age, lowering social costs, and raising social benefits leaves Clayton and other areas better off than under the existing institutional arrangements. But now Clayton, through spillouts, has a still more beneficial, albeit minor, effect upon other areas (the spillout ratio (S) rises from 1.93 to 1.94) and, more than previously, Clayton would be better off in a world without spillovers.

Changes in the Tax Structure and Migration

In both Chapters VIII and XIII, changes were introduced into the tax structure. In the cost summary several changes were considered: state funds were substitute for school district funds, state income taxes were substituted for state sales taxes, and zoning changes were made. In the benefit summary chapter changes in the tax claim on income and separate changes in the migration pattern were considered. At this point two of these, one from each chapter, will be combined to demonstrate the consequences Clayton might expect from pursuing policies which have, at first view, an appealing character.

School district residents are inclined to encourage the substitution of state funds for locally raised revenues and, through actions by Chamber of Commerce and related groups, to seek lower rates of out-migration. Both of these cases have been considered. In the case of state financing replacing part of local financing it was observed that this would be detrimental to Clayton's position: the change in cost spillins exceeds the change in costs spilled out by $86,000. The decrease in out-migration leads to a net increase in Clayton's position of $287,000. The two policies combined would be beneficial to Clayton, reducing its net cost burden from all education provided in 1959-1960 by $195,000. Clayton would still have a net cost burden, indicating that it would prefer that useful analytical, but mythical, migrationless closed economy in which no spillovers occur.

Summary

We first developed a general framework for the interpretation of spillovers in order to assist further investigations of the model employed in this study. In presenting the empirical findings of the case study, Clayton was found to realize cost burdens in excess of the benefits received from education provided in all areas. Society at large was found to gain from Clayton's education, realizing a return of $126 for every $100 of resources devoted to this purpose. With the exception of the rest of St. Louis County, all other areas studied gained from spillovers with Clayton.

In seeking to improve its net benefit position, Clayton could invest more funds in its own education. From society's point of view this is desirable, but it would mean that other areas would bear cost burdens in excess of benefits received. A compensation procedure is thereby suggested.

These findings were also considered from an equity viewpoint, with equity related to average per capita income. Spillovers between Clayton and other areas were found to operate in the direction of equity.

Finally, two modified changes were introduced into the model from earlier chapters to evaluate the consequences for Clayton and other areas of changes in the structure of costs and benefits and their spatial spillovers.

Chapter XV

POLICY IMPLICATIONS AND CONCLUSIONS

The previous pages leave little doubt that under fiscal and political federalism a modern, highly mobile, and industrialized society encounters very widespread spatial education cost and benefit spillovers. Moreover, there evidently is no automatic mechanism in the system that would either balance out social cost and benefit spillovers at the margin, or effect a positive relationship between a district's average per capita income and its net education burden. The first condition, if met, would make the financing of education consistent with efficient resource allocation, while the second would bring it into harmony with distributional equity. Simultaneous achievement of both objectives appears virtually beyond our reach. However, the Clayton case study found that spillovers between Clayton and other districts operate in the direction of distributional equity—most likely as a result of the effectiveness of progressive federal income taxation.

At this point it appears appropriate to place in sharper focus some of the key assumptions and limitations of this study. The purpose is not only to caution our readers, but more important, to encourage others to engage in research that might overcome the problems encountered here. After a review of some of the most crucial assumptions, limitations, and future research needs, we will discuss policy implications, emphasizing those instruments which can be used by local, state, and federal educational decision-makers in conjunction with the local decision-model of this study.[1]

Assumptions, Limitations of the Study, and Future Research Needs

The costs of major education programs and their benefits have an extended time horizon. Under this circumstance uncertainty is often great. We have in mind both uncertainty about the state of the world in the future and statistical uncertainty. The first type centers around such factors as the future state of the arts, levels of employment, allocation of a person's lifetime to remunerative activities, and social values. The second type reflects the chance elements in the real world, and it would exist even if uncertainties of the first type were zero. Type 2 uncertainties are usually the least troublesome and, when necessary, Monte Carlo techniques can be used to deal with statistical fluctuations. Type 1 uncertainties are much more important and present greater hazards in research.

Cost and benefit spillover analysis involves many uncertainties of both types, which are further complicated by the fact that future education takes place in an extremely complex environment and many of its variables do not appear to lend themselves to ready quantification. For these reasons the reader must remember that our estimates are bound to be partial and uncertain. In many respects they are more suggestive than definitive. However, they have the advantage of having been made in what we hope is an internally consistent framework.

Now let us turn to some of the key assumptions and the limitations they imply for our analysis and findings. The complex nature of social costs and benefits of education determined that their breakdown be somewhat arbitrary. We have selected mainly those elements for which the economist's monetary measuring rod is applicable. This does not reflect their significance either in the minds of the authors or in the minds of the nation's citizens when they make education decisions or select leaders who will form education policies. The abbreviated consideration given to some cost and benefit elements is more testimony to the investigators' limitations of intent and ability than to any lack of importance of these factors.

On the cost spillover side of the analysis a partial equilibrium analysis of tax incidence has been used throughout. This conventional approach falls far short of the theoretically more appropriate general equilibrium analysis. The complexity of the relationships forced us to select the partial equilibrium analysis, although by so doing we were unable to trace the innumerable intricate substitution effects on both the factor and product side. In a partial equilibrium analysis we are actually dealing more with money burdens than with the complete incidence.

In establishing empirical estimates of tax burden average, relations were assumed to reflect marginal conditions. Extension of the findings to a discussion of incremental investment decisions involves the assumption that such changes the school board and the electorate consider at a given time are not likely to disturb the existing conditions, being neither major in magnitude nor radical in nature.

One of the simplifying assumptions made for both the cost and benefit analyses relates to the homogeneity of interests within the community. On the cost side, earnings are foregone by the student and are of chief concern to him and his family. Similarly, the net increment to the student's or the mother's income is enjoyed by certain family units and not by others in the community. In some newer suburban areas of the nation the homogeneity of interest assumption may be quite accurate. However, if this spatial spillover analysis is to be used in the analysis of political behavior, the disparate interests of residents may require separate identification.[2]

Central to the entire analysis is the definition of the community. Among the several possible definitions, two command the most attention. Most commonly, a community is that group of persons maintaining legal residence within a given political jurisdiction at a point in time. The basis for inclusion or exclusion from that group over time may cause confusion. We have chosen to identify people with their places of residence in the period during which an education decision is being evaluated. As these people move from one area to another in subsequent periods they are identified with the area in which they resided during the initial period. This definition of community is called a local model, because each person is related to one locality for the entire analysis. Another view of the community identifies individuals with different areas of the nation according to their various residences over time. This is termed a national model. We believe the local model is to be preferred when the discussion is in terms of local decision making. The local model identifies the costs and benefits realized by a set of persons over time as the area's result of a given education decision. It states the interests of the citizens: interests vital to the political careers of their elected officials.

The national model considers events which occur within an area. It is of particular consequence in national planning for geographically balanced growth, economic welfare, and resource utilization efficiency. It is useful in identifying pockets or regions likely to experience economic conditions greatly different from the entire nation's experience. It is the model implicitly employed by businessmen in the cities and farmers in rural areas who identify their interests with a fixed geographic area, and who wish to know what is going to happen in this area. However, the local model, if disaggregated to indicate this group of persons seperately, i.e., when the homogeneity assumption is in part abandoned, can also provide the answer these individuals seek.

If the national model were employed in a study of education spillovers there would be no difference on the cost side of the analysis: all costs are incurred in the initial time period. On the benefit side, however, the national model would yield larger spillovers between areas: all of the income realized after taxes by the students who migrate would be counted as spillovers. If there were no fiscal interdependence, spillovers would be the result of migration alone. As noted in Chapter IX, under the local model benefit spillovers can result from fiscal interdependence alone, even in the absence of migration. The spillover results of the national model are more sensitive to uncertainties concerning future patterns of residence than are the estimates of the local model. We may speculate that community leaders employing the national model's concepts tend to support underinvestment in education, particularly when migration patterns are uncertain.

An analytical framework for local decision-making is subject to many pitfalls. We have considered only some of the benefits and costs of public education. Are others of more consequence to the voters?[3] Does the desire for increments to their children's income really move people to support public education? If so, why are education decisions and attendence made compulsory by legislation? One major problem that arises out of differing perceptions of costs and benefits concerns the method of allocating a community's payments to, and receipts from, the state or county government. It is a frequent point of political controversy that some areas pay more to the state than they receive in the distribution of state funds.[4] Perhaps, if one were testing actual performance in the light of spillovers, the analysis should compare results obtained from the prorated method of Chapters IV and V with a method that considered spillovers as the difference between payments and receipts.

There are many theoretical and methodological assumptions in the preceding chapters which are open to question. For example, the appropriate discount rate and the schedule of capital depreciation have each concerned the most competent scholars. One assumption employed in this study, which is of particular interest to both the professional economist and the interested citizen, is the use of market income differentials as a measure of benefits.[5] Aside from the issues related to intangible benefits of education to the individual and society, there is also the issue of the disappearance of income differentials in an economy with an abundant supply of persons with general education. Even if everyone in the labor force had a high school education and there were no income differential due to this training, we could not conclude that education was without value. In this study, however, our attention has been focused on those increments a single district could make in its education program in a world without such a high level of educational achievement. Even should twelve years or more of schooling become universal, interest in the costs and benefits of quality improvements or curriculum changes would persist.

Policy Implications for Local Government

Voters, school board members, and school officials, in balloting on school levies and bonds, exhibit little concern with global equity and resource allocation efficiency considerations, and with the effects of local policies upon other districts. Rather, their main interest is in the improvement of their own education benefit-burden status, and their main effort is likely to focus on effecting favorable changes in the gross education benefit-burden ratio, along with a concomitant increase in cost burden spillouts.

With regard to public education, there are four possible steps that local governments can take to improve their benefit-burden status. First, there are certain means by which voters and school boards can tap more fully the financial resources of other local governments, as well as the state and federal governments. Secondly, the school district can join forces with the municipal government in devising local industrialization policies that can help shift some of the burden of financing local public education to non-residents. The third step is to improve the quality of education offered by a community. Improvement in education quality not only can affect the in- and out-migration pattern, and in turn the community's benefit-burden relationship, but more importantly, will enable the community's students to realize still greater financial returns from their years in school. As long as the claim by governments on such incremental earnings are not confiscatory, the gross benefits of the district will rise. However, the ability of the community to shift the costs associated with higher quality education must be considered in evaluating the fiscal consequences of such programs. Economists have begun to provide assistance to educators in the analysis of the relations of education quality and costs and benefits, but the indications are clear that additional efforts are required.[6]

Finally, and of minor consequence, by putting school facilities to multiple purpose uses (for social and cultural activities) and integrating them with the community's recreational facilities, the cost spillover pattern can be modified.

We will come back to a discussion of the first instrument when state and federal policies are being considered. Here more will be said about local industrialization steps.

One of the forces generating public education cost and benefit spillovers is the economic structure of the community, more specifically, its industrialization status.[7] The decision to locate a new industrial plant in a community will affect the provision of public education, not only in the immediate community in which the plant is located, but throughout the much larger region in which it makes its purchases and where it sells its products. The nature and magnitude of the spillover and general fiscal impacts of industrialization are of much interest.

The location of a new chemical plant, for example, or the expansion of an existing plant within a school district can have major direct effects. If there is full employment within the community and undeveloped residential land is available, some of the new employees will locate within the school jurisdiction and there will be an immediate increase in the number of pupils attending the public schools of the community. The homes of the new employees will also raise the residential tax base of the school district and the increased enrollment can change both the burden and benefit status of the community.

A percentage of the new employees may settle outside the district. This will have an indirect effect on the provision of public education in the area surrounding the district in which the plant is located as increases in enrollment and in the tax base outside the district affect cost and benefit spillovers. Also, the purchase of additional raw materials by satellite firms throughout the region will, in turn, expand their plant and input requirements. Thus, indirectly, the public education burden and benefit pattern of school districts throughout the region can be affected.

Furthermore, there are income-induced effects. The new plant will directly and indirectly generate income increases which, in turn, means an increased tax base and income benefits on the one hand, and more employment and more employees with children who require education, on the other.

In summary, the plant location decision will lead to direct, indirect, and income-induced changes in the provision of public education inside and outside the community, which can change the magnitude and pattern of public education cost and benefit spillovers. An industrialization model can be integrated with the intercommunity cost and benefit spillover models. In order to consider the direct, indirect, and income-induced effects of industrialization, this model uses regional input-output or interindustry relations tables to generate information that can be fed directly into the intercommunity cost and benefit spillover models.

The industrialization model has been presented and implemented with regard to cost and revenue considerations for the St. Louis SMSA.[8] Different types of industrialization have distinctly different impacts on annual property tax yields and school costs, respectively. The total annual school cost increased property tax revenue, generated by a one million dollar final demand increase, varied from a low of $7,688 in the case of the food industry, to a high of $17,654 in the case of the plumbing and heating supply industry. The associated annual school cost increases exhibited even wider variation. The products of petroleum and coal industries were on one end of the spectrum with an annual cost increase of $4,704, and the motors and generators and lumber and furniture industries at the other end with an annual cost increase of $21,623.

We can define the balance between direct, indirect, and income-induced contributions made by school districts, and their direct, indirect, and income-induced public education cost, as the district's net fiscal resources status. The greatest loss in the net fiscal resources status was incurred when industrialization took the form of textile and apparel manufacturing. Here, a one million dollar final demand increase resulted in a $7,356 deterioration of the net fiscal resources status of the district. Industrialization also led to major losses when it took the form of leather and leather products, motors and generators, and lumber and furniture industries. Net gains resulted from products of petroleum and coal, chemicals, and motor vehicles industries. In general, it can be said that the most improvement in a district's net fiscal resources status results from the expansion of an industry that has major direct, indirect, and income-induced income effects while having only minor employment effects.

After changes from industrialization in the district's cost and revenue pattern have been estimated, their spatial spillover implications can be estimated with the aid of the models developed in Chapters III through VII.

The industrialization model also helps to generate population, school enrollment, and income estimates, information crucial for projecting the benefit impact of industrialization. This information needs to be translated into present value benefit terms before the benefit spillover models are applied to estimate changes in spillover patterns.

Federal and State Policies

The local decision model is primarily intended to be applicable to local school districts concerned with improving their benefit-burden position. Their actions, however, can prove inconsistent with the nation's (or a state's) overall interests. Therefore, it might be desirable for federal and state education policy-makers to apply the local decision model and use it to test federal and state policies to bring local education decisions into closer harmony with the national interest.

There are a number of fiscal instruments available to the federal decision-maker to improve the benefit-burden position of local school districts, some of which can be applied by state governments as well. Four will be mentioned here: (1) grants-in-aid; (2) federal and state tax offset provisions; (3) advance payments for the education of children and grandchildren through endowment funds (somewhat like the social security program); (4) earmarked income tax collections allocated to the school district which provided an individual's education.[9] Of these, the first two are widely employed, while the other two, to the best of our knowledge, have not been tried in the United States. It would be interesting to analyze some of the pros and cons of the latter two fiscal instruments.

Grants-in-aid, because of their widespread use, require attention.[10] Most grant-in-aid programs are designed to supplement an existing local effort and not replace local funds by state and/or federal funds. However, a federal grant which substitutes for state aid to local schools offers a convenient point of departure. If the federal and state grants are of equal magnitude and neither had strings attached which ultimately could affect education quality or productivity, benefits are unlikely to be affected. However, changes in the burden pattern are likely to take place as a result of the substitution of federal for state funds.[11] The school district itself would barely notice the change in sources. Since the total expenditures remain unchanged and since no strings had been attached to either state or federal aid, which means that the district's quality of education and productivity would not be affected, school district decision-makers are unlikely to react to the financing in a way that could bring about a changed benefit picture. Benefits might be affected in a very minor way due to the new geographical burden pattern as it leads to migration or the ability to support local taxes.

About the same situation will prevail if federal or state grants-in-aid are substituted for local funds without strings attached.[12] In this case school districts can either reduce taxes or use parts or all of the savings for other educational services, ultimately enhancing benefits. These changes can even be greater if the state or federal government specifies performance criteria to qualify for aid.[13] The conditions for aid can induce greater financial effort, quality improvements, productivity measures, use of more progressive local taxes. For example, to assume quality improvement, a program requires that the school district undertake experiments with new teaching devices, intensify the education program, and/or lengthen the school year. Productivity could be increased by requiring small school districts to consolidate, make more judicious capital improvements, and adopt cost-saving measures.

As was mentioned earlier, most federal and state aid programs are designed to increase the overall investment in public education. Thus, they tend to complement local funds. In terms of complementarity, several different programs can be visualized. In two unlikely cases either state or federal funds are added on top of prevailing contributions by the other levels of government. More commonly state and/or federal aid is contingent upon an increased district contribution to public education expenditure. In the first two cases, the aid can take the form of a fixed percentage, a varying percentage, or an amount determined by specified criteria. The other types of complementary aid can not only take these three forms but also can stipulate payments to be made if and when district and/or state education expenditures exceed a specified amount. Complementary aid programs are likely to affect in a major way both costs and benefits of school districts.

In addition to the four instruments which could be used by both federal and state governments, benefit and cost spillovers can be modified indirectly by a more effective dissemination of information on how schools can improve the quality and productivity of education. Furthermore, the placing of major federal installations and contracts in specified districts and the awarding of federal funds to the schools of such areas under Public Laws 815 and 874, or modifications thereof, can greatly affect the spillover patterns.[14] In this case, relaxation of the homogeneity assumption would appear a profitable technique. A benefit-burden spillover study of impacted areas would separate the district into those household units whose presence is directly or indirectly, yet in a major way, related to the activity of the federal government and those not so related. It would provide data for the assignment of fiscal responsibility on a more sophisticated basis than merely enumerating the number of children in each group.

Finally, there are some regulatory measures. The first involves a radical step which would be a major departure from American tradition, the enlargement of decision-making units in order to internalize more of the benefits. Merging our tens of thousands of school districts into thousands, or hundreds, or one, would reduce spatial spillovers. However, spillovers are only one of the considerations that enter into deliberations about school district mergers. This general concern has been investigated by one of the authors elsewhere.[15] The advantages have been found insufficient to advocate mergers in general, certainly not as a major policy for implementation in all areas. A second regulatory step is being used in the United States in conjunction with fiscal devices. Mandatory minimum performance requirements, so far, have mainly been used by states and can affect in a major way cost and benefit spillovers.

Some Final Thoughts

The widespread intercommunity benefit and cost spillovers of public education have led to serious discussions of two important policy issues—underinvestment in education and the need for greater federal financing.

First let us analyze, with the aid of the concepts and models developed in this study, the argument of underinvestment in education recently advanced by Burton A. Weisbrod. Using what we refer to as a national model, Weisbrod suggests that there exists a lack of symmetry with respect to the effects of benefit spillins and spillouts. He states:

> To some extent, a community is to the nation what a purely competitive firm is to the industry; thus, the spill-ins (or imports) of benefits to a community from education provided elsewhere may be largely independent of its own education expenditures. To the extent that they are, the spill-ins constitute fixed benefits; as such they have no influence on decisions on the margin, assuming community welfare maximizing behavior.[16]

And he concludes:

> The tendency of benefit spill-outs to cause underexpenditure

> in education does not have its counterpart in a tendency of benefit spill-ins to cause overexpenditure.[17]

Weisbrod continues to argue that underinvestment in education does not require complete independence of benefit spillins from its own educational activities, but merely that some migrants are unaffected by the level of education expenditures in the community.[18]

Weisbrod's underinvestment argument is based solely on benefit spillover considerations—cost spillover aspects are neglected. If this argument were to be applied to the cost side it might run as follows: since a community is to the nation what a purely competitive firm is to the industry, cost spillins constitute fixed burdens on the community and they have no influence on decisions at the margin. Not so with cost spillouts, which can be influenced by the community. The result is overinvestment.

In short, this argument, *if applied to costs as well as benefits*, leads to a conclusion of underinvestment in some instances, and to overinvestment in others. For example, if a community's internal ratio is less than 1 and its production ratio is greater than 1, spillout of costs and benefits results in underinvestment (Case 9, Table 87); however, if the community's internal ratio is greater than 1 but its production ratio is less than 1, spillouts conversely result in overinvestment (Case 7, Table 87).

Our theoretical analysis, considering education alone among government services, has shown that cost and benefit spillins have a bearing on local investment decisions. For example, if a local community's spillin ratio is greater than its internal ratio, the local community can improve its gross ratio (increase local wealth) by encouraging an increase in other areas' public education expenditure, whose production ratios, however, may be less than 1. If cost spillins operate as a constraint upon a community's ability to provide the desired level of public education, even though its internal and production ratios are greater than 1, underinvestment results.

In theory, if cost spillins are functionally related to the level of local public education expenditure, as through the financing and apportionment of state aid, a community will underinvest in its own education, even though its internal ratio is greater than 1, if the internal benefits of additional local education do not more than compensate for induced cost spillin.

But, in considering the behavioral implications of the existence of spatial cost and benefit spillovers, a sharp distinction needs to be made between cost spillouts and the other three spillovers.[19] Cost spillouts from a given district reduce its education costs. Cost spillins have at best only little bearing on its education vote on the policy the district adopts. In this respect they are in the same class entirely as are cost spillins from taxes used to finance other government expenditures. Benefit spillins have at best only a minor substitution effect. Benefit spillouts seem very difficult to interpret and the voter is therefore somewhat at a loss to be guided by them. This analysis would suggest that intercommunity spillovers, which are so prevalent under fiscal federalism, could lead to a more favorable school vote than would be expected under a single centralized fiscal arrangement.

Furthermore, to the extent that our local decision-making model is applicable and more people out-migrate than are expected to do so at the time of the school levy election, a downward benefit bias would result, possibly reinforcing the tendency mentioned in the previous paragraph. We hasten to point out that this conclusion does not mean that the nation overinvests in education. Instead, we have merely analyzed one of many factors bearing on the education vote.

Finally, what are the pros and cons for greater federal participation in the financing of education? Various instruments for federal participation have been mentioned, from dissemination of information to wholesale school district merger. When distributional equity and resource allocation efficiency are not realized through local and state financing because of spillovers, the federal government is in a position to help the states and their school districts achieve these commonly shared goals.[20] Few local or state means are as effective as the progressive federal income tax for establishing and maintaining distributional equity. Few local or state financing programs for improvements in education can be as successful as federal grants accompanied by the full and energetic support of the executive branch. However, such steps require—in conception, implementation, and advancement to the public—dissociation from restrictions on the freedom of action essential to local communities and the states.

Trading off the advantages and disadvantages of greater federal participation in the financing of American education involves a variety of philosophical issues and value judgments. The most appropriate instruments appear to be effective grants-in-aid associated with certain limited performance requirements. However, there are many who oppose broadening the scope of the federal government and reducing local freedom of action. On the other hand, freedom of local districts to act can also mean freedom not to act on improving our schools and the education received there by our children.

APPENDIX

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Appendix

PROCEDURE, DATA, AND FINDINGS OF THE MIGRATION MODEL

The following discussion details the statistical procedures and data sources used to estimate each cell entry of the initial transition matrix.* This matrix shows the changes in residence between the six areas of the study for all persons living in the United States in 1959. It inducates the number of persons in each area's initial population who died between 1959 and 1960 and the number of persons born in each area. This is the matrix described: by Fig. 12 and Table 68, in which each entry is designated by the general term M_{ij}. Each row ($i=1,\ldots,6$) represents the entire 1959 population of an area with the final row ($i=7$) representing those born in 1960. Each column ($j=1,\ldots,6$) represents the entire 1960 population of an area with the final column ($j=7$) representing those persons who died during the year. The data for natural change were the registered births in each area for 1960 and the registered deaths for 1959.[1] We assume that these calendar year data correspond to the 1959-1960 time period of the study. Table 90 presents the findings based on the procedure described:

M_{1j} and M_{i1}: the first row and column of the matrix indicate the 1959-1960 exit from and entry to Clayton. The distribution by geographic area was computed from a three-year special study of pupil mobility in the Clayton School District.[2] The average annual 1961-1963 student in- and out-migration for Clayton was computed for each of the six geographic areas. Assuming that the total population has a geographic migration pattern similar to that of the public school children, the data were then increased by

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* The data for this appendix were developed and organized in a large part by Stanley M. Berman.

Table 90

Population Transition Between Select Study Areas of the United States, 1959-1960

		Clayton School District (1)	Rest of St. Louis County (2)	City of St. Louis (3)	Rest of SMSA (4)	Rest of Missouri (5)	Rest of the U.S. (6)	Deaths (7)	Total, 1959 (8)
Clayton School District	(1)	13,449	948	125	20	63	475	167	15,247
Rest of St. Louis County	(2)	780	630,854	3,306	543	1,667	12,831	4,432	654,413
City of St. Louis	(3)	236	23,241	710,498	4,994	1,605	12,357	10,179	763,110
Rest of SMSA	(4)	39	1,333	1,270	570,576	802	6,170	5,249	585,439
Rest of Missouri	(5)	81	2,697	2,655	2,520	2,639,855	70,631	30,394	2,748,833
Rest of U.S.	(6)	468	12,902	12,740	12,058	53,200	169,398,397	1,609,766	171,099,531
Births	(7)	192	16,312	19,432	15,654	49,716	4,156,544		
Total, 1960	(8)	15,245	688,287	750,026	606,365	2,746,908	173,657,405		

Total 1959: 175,866,573
Total 1960: 178,464,236
Population growth: 2,597,663

the 1960 Clayton ratio of total population to public school population.[3] Since the Clayton School District includes some individuals residing in the adjoining municipality, Richmond Heights, and Census data apply only to the municipality of Clayton, the Clayton pupil mobility data were reduced by the ratio of Clayton resident students to total Clayton School District enrollment for 1959-1960.[4] To adjust for births already included in Clayton's total 1960 population, each cell entry was then reduced by the proportion which total 1960 births in Clayton were to total 1960 Clayton population.

M_{32}: A total of 109,292 persons residing in St. Louis County in 1960 reported that they lived in the "Central City of this SMSA (St. Louis City) in 1955."[5] To allow for greater migration at the end rather than at the beginning of the 1955-1960 period, and to allow for persons who migrated more than once during the 5-year period, the 5-year rate of migration was converted to an annual 1959-1960 rate by multiplying by 0.22 rather than by 0.20. The annual rate was further reduced by the proportion of total 1960 births in the rest of St. Louis County to total 1960 rest of St. Louis County population, for the estimated 23,241 number of persons who migrated from St. Louis City to the rest of St. Louis County.

M_{42}: A total of 133,778 persons residing in St. Louis County in 1960 reported living in "Other part of this SMSA" in 1955.[6] Persons who merely moved within St. Louis County, i.e., those persons that moved but remained within St. Louis County ("different house, same county") was subtracted,[7] and the resulting 5-year migration was reduced to an annual 1959-1960 rate by again multiplying by 22 per cent. A further downward adjustment was made for births in St. Louis County already included in St. Louis County total 1960 population and for Clayton's in-migration from area 4, for the resulting estimate of 1,333.

M_{52} and M_{62}: A total of 75,152 persons in St. Louis County in 1960 reported living "outside the St. Louis SMSA" in 1955, including residence abroad and residence not reported.[8] The estimated 1959-1960 migration rate, adjusted for births in the period already included in St. Louis County total 1960 population, and further adjusted for Clayton in-migrants, is 15,599. Since St. Louis County and Clayton have similar demographic characteristics, the estimated 15,599 in-migrants were divided between area 5 (the rest of Missouri) and area 6 (the rest of the United States) in the same proportion as Clayton in-migration from these areas, i.e., 2,697 and 12,902, respectively.

M_{23}, M_{24}, M_{25}, and M_{26}: Net in-migration to St. Louis County for the period 1959-1960 was 204,312, of whom 11 per cent were assumed 1959-1960 net in-migrants.[9] St. Louis County gross out-migration, excluding inter-Clayton - St. Louis County migration and deaths, may be estimated as the difference between St. Louis County gross in-migration and net in-migration. Total in-migration to St. Louis County was 40,997, i.e., $\sum_{i=3}^{6} (M_{i1} + M_{i2})$. Out-migration from St. Louis County, excluding inter-Clayton - St. Louis County migration and deaths, is therefore 19,030. Out-migrants from Clayton, i.e., $\sum_{j=3}^{6} M_{1j} = 683$, must be subtracted from St. Louis County out-migration to derive estimated total out-migration from area 2, the rest of St. Louis County. Given the demographic similarity between Clayton and St. Louis County, M_{23}, M_{24}, M_{25}, and M_{26} were computed, assuming the same pattern of out-migration as for Clayton.

M_{43}: The number of persons living in the city of St. Louis who were residing in some other part of the St. Louis SMSA in 1955 was 21,936.[10] The number of 1959-1960 migrants from the rest of the St. Louis SMSA to

St. Louis City was derived from the 5-year total by assuming 22 per cent migrated in the final year, subtracting the number of persons previously estimated to have resided in Clayton and the rest of St. Louis County, and by adjusting for births separately included.

M_{53} and M_{63}: Persons residing in the city of St. Louis in 1960 who resided outside the St. Louis SMSA in 1955 (including abroad and not reported) numbered 71,676.[11] Again adjusting for births separately identified and assuming 1959-1960 migration as 22 per cent of the 5-year rate, the estimated number of St. Louis City in-migrants were then allocated between areas 5 and 6 in the same proportion as in-migrants from these areas to Clayton and the Rest of St. Louis County.

M_{34}: The number of 1960 residents in St. Charles and Jefferson counties, Missouri, and in Madison and St. Clair counties, Illinois, who resided in the "central city of the SMSA" in 1955, was 23,302.[12] The 1959-1960 migration rate was estimated as 22 per cent of the 5-year rate, adjusted for the number of births in the rest of the St. Louis SMSA separately included.

M_{54} and M_{64}: The total number of individuals in area 4 in 1960 residing outside the St. Louis SMSA in 1955 was 215,012 (including abroad and not reported).[13] The 1959-1960 estimate was assumed 22 per cent of the 5-year rate, and adjusted for area 4 births in 1960 separately identified. The number of migrants into areas 1, 2, and 3 from outside the St. Louis SMSA were then subtracted to obtain the estimated number for area 4. The area 4 in-migrants were then allocated between areas 5 and 6 in the same proportion as for St. Louis City and the rest of St. Louis County.

M_{35} and M_{36}: The procedure is similar to that used to estimate outmigration from the rest of St. Louis County. Net migration from the city of St. Louis in the period 1950-1960 was -207,577.[14] The 1959-1960 net migration was then estimated as 11 per cent of the 10-year rate, and adjusted for births separately identified. Total in-migration to St. Louis City in 1959-1960 was previously estimated as 20,096. Subtracting St. Louis City net migration from in-migration results in an estimated St. Louis City out-migration of 42,433. Out-migration from St. Louis City to areas 5 and 6 combined was then estimated as 13,962, the difference between total St. Louis City out-migration, and out-migration to the other three areas. St. Louis City out-migration to areas 5 and 6 was then allocated, based on the same proportion as estimated out-migration to these two areas from Clayton and the rest of St. Louis County.

M_{45} and M_{46}: Total out-migration from area 4, the rest of the St. Louis SMSA, was again first estimated by subtracting net migration from in-migration. The 10-year net migration for the St. Louis SMSA was 65,362.[15] The one-year 1959-1960 estimate was assumed 11 per cent of the 10-year rate, and adjusted for births separately identified. In-migration to areas 1 through 4 from areas 5 and 6 was subtracted from the out-migration from areas 1 through 4 to areas 5 and 6. Net out-migration from areas 1 through 4 to areas 5 and 6 was subtracted from the estimated total out-migration from the St. Louis SMSA to obtain the net out-migration from area 4 to areas 5 and 6. Out-migration from area 4 to areas 5 and 6 was distributed in the same proportion as out-migration to these areas from St. Louis City.

M_{65}: Persons living in Missouri in 1960 who resided outside of the state in 1955 numbered 424,213.[16] The 1959-1960 number was estimated as 22 per cent of the 5-year rate, adjusted for births. In-migration to areas 1 through 4 from area 6 was then subtracted from total in-migration to obtain the estimate for the "rest of the state."

M_{56}: Net 1959-1960 migration from the state was first computed by converting 1950-1960 net migration to an annual basis, and adjusting for births.[17] Subtracting net migration from in-migration results in estimated out-migration from the state. Subtracting out-migration from areas 1 through 4 from total state out-migration yields the estimated out-migration from the "rest of the state."

M_{11}, M_{22}, M_{33}, M_{44}, M_{55}, and M_{66}: The diagonal entries of the matrix, i.e., the non-migrant residents of the areas, are the computed difference between each area's total 1960 population and total in-migrants (including births) during the 1959-1960 period. They are also the computed difference between each area's total initial 1959 population and total out-migration (including deaths) during the 1959-1960 period.

The benefit spillover equations, which are implemented for the empirical case study analysis of fiscal interdependence with changing population, are now summarized.* While the equations relate specifically to student education benefits, the model is also applicable to an analysis of spillovers related to other initial beneficiaries, i.e., students' mothers or co-workers.

The probability of a person at area (i) at time (t) being at area (j) at subsequent time (t+1) is P(i,j,t+1), i.e., the row entries in matrix of Table 69:

$$\text{(1A)}\quad P(i,j,t+1) = \sum_{k=1}^{1} P(i,k,0)\ .\ P(k,j,t)$$

where,

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* We are indebted to Professor Anthony Oberschall, Department of Sociology, University of California, Los Angeles, for aid in developing the equations and programming the analysis for the IBM 7040.

P = probability

i = initial area of residence at time zero

j = area of residence at some future time

t = a point in time, t = 1,2,...,55

k = dummy index for summation

0 = initial time period

Of the total student population at time zero, the absolute number in area (j) at time (t) is S(j,t), i.e., the column totals in matrix of Table 68:

$$\text{(1B)} \qquad S(j,t) = \sum_{i=1}^{7} S(i,0) \cdot P(i,j,t).$$

The total number of students in area (j) at any time (t), identified by their area of residence at time zero, is R(i,j,t), i.e., the column entries in matrix of Table 68:

$$\text{(2)} \qquad R(i,j,t) = S(i,0) \cdot P(i,j,t).$$

Note that equation (1B) can be rewritten in terms of R(i,j,t):

$$\text{(1B')} \qquad S(j,t) = \sum_{i=1}^{7} R(i,j,t).$$

The per cent distribution of students in area (j) by area of origin (i) at time (t) is Q(i,j,t), i.e., the column entries in matrix of Table 70:

$$\text{(3)} \qquad Q(i,j,t) = \frac{R(i,j,t)}{S(j,t)}.$$

The total present value benefits of education provided in area (i), which accrues to students when residents of area (j) at time (t) is D(i,j,t):

$$\text{(4)} \qquad D(i,j,t) = \frac{(\$151.00) \cdot R(i,j,t)}{(1.05)^{t}}$$

where,

($151.00) = constant average annual increment in earnings accompanying an additional

year of education

$(1.05)^t$ = constant 5 per cent annual compound rate of discount

$t = 6,...,55$

The total present value benefit of education provided in area (i) and realized during the period (t=6,...,55), without respect to area of residence at the time the benefits are actually realized, is T(i,t):

$$\text{(5A)} \qquad T(i,t) = \sum_{j=1}^{6} D(i,j,t).$$

The total amount of FEDERAL tax reduction benefits of education provided in area (i) which ultimately accrue to non-student beneficiaries while residents in area (j) at time (t) is B(i,j,t):

$$\text{(5B)} \qquad B(i,j,t) = (0.121) \cdot T(i,t) \cdot c(j)$$

where,

(0.121) = constant proportion of total incremental dollar benefits incurred as federal tax burden

c(j) = the federal spatial tax coefficient vector, which is constant in time

Total present value FEDERAL tax reduction benefit spillover of education provided in area (i) which accuresto non-student beneficiary residents of area (j) at time (t), identified with the non-student beneficiaries' area of residence at time zero, is A(i,j,t):

$$\text{(6)} \qquad A(i,j,t) = \sum_{k=1}^{6} B(i,k,t) \cdot Q(j,k,t)$$

where,

k = a dummy index for summation

Since the spatial tax shifting pattern, mechanism, and burden of STATE and LOCAL government taxes is different than that of FEDERAL taxes, equations (5A) and (5B) change in the spillover analysis of these taxes.

The total present value dollar benefit of education provided in area (i) and realized during the period (t=6,...,55) while students are residents of area (j), is identified with the area (k) which initially realizes increased STATE and LOCAL government tax revenue because of tax burden borne by students while residing in areas (j), is T(i,j,t):

$$\text{(5A')} \qquad T(i,j,t) = \sum_{k=1}^{6} D(i,k,t) \cdot b(j,k)$$

where,

D(i,k,t) = total present value benefit of education provided in area (i) which accrues to students when residents of area (j) at time (t)

b(j,k) = constant STATE and LOCAL government tax burden spillin coefficients of area (j) from (k), i.e., the row entries of Table 66

The areas (k) which realize increased STATE tax revenue benefits as a result of education provided in area (i), reduce tax rates, with total tax reduction benefits ultimately accruing to non-students, while residents in areas (j), i.e., B(i,j,t):

$$\text{(5B', STATE)} \qquad B(i,j,t) = (0.044) \sum_{k=1}^{6} T(i,k,t) \cdot c(k,j)$$

where,

(0.044) = constant proportion of total incremental dollar benefits incurred as STATE tax burden

c(k,j) = constant STATE and LOCAL government tax burden spillout coefficients of area

(k) to area (j), i.e., the row entries of Table 65

(5B', LOCAL) Replace (0.044) by (0.041) in (5B', STATE) above.

Implementation of our stable population transition rate pattern for the six study areas comprising the entire United States population appears to give reasonable projections of the total United States population. Our projection of the population of the entire United States for year 2000 is 309 million. A recent actuarial study provides six illustrative United States population projections.[18] Of the six projections, two involved "very high fertility" assumptions, and were regarded as mainly of academic interest. Accordingly, the degree of variation that might "reasonably be expected" in this regard was as follows:

	Fertility	Mortality	Year 2000 (In Millions)
Projection I	Low	Low	272
Projection II	Low	High	263
Projection III	High	Low	343
Projection IV	High	High	332

Our projection falls between the second and third actuarial projections, conforming to "average" fertility and mortality rates. On the basis of our stable transition rate model we project the following populations in the year 2000:

	Population in the Year 2000 (In Millions)
Clayton School District	0.03
Rest of St. Louis County	1.84
City of St. Louis	0.71

	Population in the Year 2000 (In Millions)
Rest of SMSA	1.58
Rest of Missouri	3.29
Rest of United States	302.00

Further computation from the transition probability matrices Table 91 indicates that only 0.9 per cent of the initial residents of Clayton in 1959 will reside there after 40 years, over 68 per cent will have outmigrated, and almost 31 per cent will have died. These results may be compared with Census data which show, for example, that only 4.9 per cent of the 1960 residents of St. Louis County, 4.4 per cent of St. Louis City, and 11.4 per cent of rural Missouri lived in the same house since 1939 or earlier.[19] While the projections of the population model are not unreasonable when compared with similar projections by others, the numerous assumptions of social and economic behavior of the combined interaction analysis show that there is room for profitable interdisciplinary advances in methodology.

Table 91

Selected Transition Probabilities of the 1959-1960 Population for the Year 2000, by Area

Area	(1) Non-Migrant (same area)	(2) Out-Migrant (other 5 areas)	(3) Death	(4) Total
1	.009	.684	.307	1.000
2	.260	.466	.274	1.000
3	.074	.584	.342	1.000
4	.362	.332	.306	1.000
5	.202	.457	.341	1.000
6	.675	.010	.315	1.000

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NOTES

Chapter I

1. J. de V. Graaff, Theoretical Welfare Economics (Cambridge: Cambridge University Press, 1957), 135 p.

2. An alternative period of time which has logical validity is twelve years, the span usually required for the completion of an individual's primary and secondary education. But here the investigation would not be focused upon a single decision, but rather on a progression of interrelated decisions made over a long span of time. The context in which each successive decision was made would be lost unless one is willing to stretch ceteris paribus to an extreme.

3. James M. Buchanan, Fiscal Theory and Political Economy (Chapel Hill: University of North Carolina Press, 1960), p.83.

4. It is convenient to assume that the school district is coterminous with a municipality. This is a convenient assumption for an analysis of municipal services supplied free of charge to school districts and can be eliminated without great harm.

5. This is similar to the approach taken by James Q. Wilson and Edward C. Banfield, "Voting Behavior on Municipal Public Expenditures," a paper presented to the Second Conference on Urban Expenditures, New York University, February 21-22, 1964, 32p.

6. See Anthony Downs, An Economic Theory of Democracy (New York: Harper, 1957), 310 p.

7. For the sake of simplicity, we will assume that the Richmond Heights portion of the school district has the same demographic and economic characteristics as the city of Clayton.

8. National Education Association, *Rankings of the States, 1960* (Washington, 1960), p. 28.

9. David Pittman and Sarah Boggs, "Analysis of Population and School Enrollment Trends in the Clayton School District" (St. Louis: Social Science Institute, Washington University, 1962), p. 51.

10. U.S. Bureau of the Census, *U.S. Census of Population: 1960, General Social and Economic Characteristics—Missouri*, Final Report PC(1)-27C (Washington: U.S. Govt. Printing Office, 1962), Table 73, p. 227.

11. U.S. Bureau of the Census, *U.S. Census of Population: 1960, General Social and Economic Characteristics—United States Summary*, Final Report PC(1)-1C (Washington: U.S. Govt. Printing Office, 1962), Table 76, p. 207.

Chapter II

1. George J. Stigler, *The Theory of Price* (New York: The Macmillan Co., 1954), p. 99.

2. Gary S. Becker, "Investment in Human Capital: A Theoretical Analysis," *Journal of Political Economy*, Supplement, LXX (October, 1962), p. 14.

3. *Ibid.*, pp. 15-16.

4. Albert R. Munse and Eugene P. McLoone, *Public School Finance Programs of the United States 1957-58*, U.S. Office of Education OE-22002 Misc. No. 33 (Washington: U.S. Govt. Printing Office, 1960), Table 2, p. 13.

5. *Ibid.*, Table 12, p. 24.

6. U.S. Bureau of the Census, *Detail of State Tax Collection in 1961*, G-SF61-No. 4 (Washington: U.S. Govt. Printing Office, 1961), Table 1, p. 3.

7. In 1957-58, non-tax revenues accounted for only 3-6 per cent of revenue raised by local school districts, about 4-5 per cent of state revenue, and from 3-4 per cent of intermediate level governments (county, etc.). U.S. Office of Education, *Statistics of State School Systems 1957-58*, OE-20020-58 (Washington: U.S. Govt. Printing Office, 1961), Table 25, p. 48.

8. Strictly speaking, differences between direct expenditure and current tax revenue of a school district, which result in changes in school district cash balances, are a cost burden upon past period taxpayers if cash balances are drawn down, or are a reduction of burden in the future if cash balances are increased. Such an analysis would require knowledge of past or future tax shifting and migration patterns; we abstract from this temporal problem by assuming that costs financed from cash balances are a cost burden to taxpayers in the current time period.

9. U.S. Bureau of the Census, *loc. cit.*

10. U.S. Office of Education, *Preliminary Statistics of State School Systems 1959-60*, OE-20006-60 Circular No. 663 (Washington: U.S. Govt. Printing Office, 1961), Table 3, p. 10.

11. U.S. Office of Education, *Financing Public School Facilities*, Misc. No. 32 (Washington: U.S. Govt. Printing Office, 1959), Table 4, p. 13.

12. However, even the elemental school district may help finance elementary or secondary education in another area to the extent that it

is a non-operating district, or if it pays the tuition of resident students attending public schools in other areas.

13. Charles S. Benson has an excellent discussion of state incentive grants in Jesse Burkhead, *Public School Finance: Economics and Politics* (Syracuse, N.Y.: Syracuse University Press, 1964), with chapters by Bertram M. Gross and Charles S. Benson, Chapter IX, "State Aid Patterns," pp. 205-35.

14. Munse and McLoone, *op*. *cit*., Table 21, p. 36.

15. *Ibid*., Tables 22, 23 and 25, pp. 37-40.

16. Alternatively, since St. Louis paid in state taxes of $30 million and received back in state apportionments $20 million, only the difference of $10 million may be viewed as cost spillover. While this procedure results in the same *net* amount of cost spillover, it fails to show the total amount of spillovers (spillins and spillouts) involved.

Chapter III

1. This and other problems of tax incidence were clarified by the detailed comments of Harold M. Groves.

2. U.S. Bureau of the Census, *U.S. Census of Governments: 1962, Public School Systems in the United States, 1961-62*, Preliminary Report No. 3 (Washington: U.S Govt. Printing Office, 1962), p. 2.

3. James N. Morgan, Martin H. David, Wilbur J. Cohen, and Harvey E. Brazer, *Income and Welfare in the United States* (New York: McGraw-Hill, 1962), pp. 289-90.

4. U.S. Bureau of the Census, U.S. Census of Governments, 1957: Taxable Property Values in the United States (Washington: U.S. Govt. Printing Office, 1959), V, p. 11.

5. Harold M. Groves, Financing Government (4th ed.; New York: Henry Hold and Co., 1954), p. 135.

6. Cited by Elbert W. Segelhorst, "A City's Balance Sheet of State and Local Government Services" (unpublished Master's Thesis, Washington University, 1958), p. 26 and Table 1, p. 38. The 1955 estimates were adjusted to reflect the commercial growth of Clayton from 1955 to 1960.

7. Harland Bartholomew and Associates, A Report Upon the Master Plan Clayton, Missouri (St. Louis, September, 1958), Table 2, p. 11.

8. U.S. Bureau of the Census, Census of Housing: 1960, States and Small Areas—Missouri (Washington: U.S. Govt. Printing Office, 1961), I, Pt. 27, Table 24, p. 54.

9. Harland Bartholomew and Associates, 1959 Land Use Inventory St. Louis County, Missouri (St. Louis, August, 1959), Plate II, p. 5.

10. Method used in computing occupancy category percentages for residential property:

1. Median value owner occupied dwellings divided by assumed period of depreciation ($30,100 / 20 = $1,505).
2. Median contract monthly rental multiplied by twelve months (115 x 12 = $1,380).
3. Ratio of owner imputed yearly rental to yearly rental payments ($1,505 / $1,380 = 1.09).
4. Percentage of owner occupied dwelling units multiplied by imputed rental ratio (42% x 1.09 = 46%).

5. Total residential dwelling units less adjusted percentage owner occupied (100% - 46% = 54%).

11. Clayton Chamber of Commerce, *Membership Roster and Business Directory* (Clayton, Missouri, 1957), 31 p.

12. Elbert W. Segelhorst and Stanley M. Berman, "Regional Tax Shifting and Incidence Studies" (Institute for Urban and Regional Studies, Washington University, St. Louis, Missouri, November 16, 1961), 37 p. (Mimeographed).

13. Richard A. Musgrave and Darwin W. Daicoff, "Who Pays the Michigan Taxes?" *Michigan Tax Study, Staff Papers* (Lansing, Michigan, 1958), pp. 131-83.

14. Harold M. Groves and W. Donald Knight, *Wisconsin's State and Local Tax Burden* (Madison, Wisconsin: University of Wisconsin Tax Study Committee, 1959), 152 p.

15. Oswald H. Brownlee, *Estimated Distribution of Minnesota Taxes and Public Expenditure Benefits*, University of Minnesota Studies in Economics and Business No. 21 (Minneapolis: The University of Minnesota Press, 1960), 45 p.

16. Musgrave and Daicoff, *op*. *cit*., p. 145.

17. Segelhorst and Berman, *op*. *cit*., p. 8.

18. *Ibid*., p. 28.

19. Segelhorst, *op*. *cit*., Appendix A, pp. 233-35.

20. Wilbur Smith and Associates in cooperation with the U.S. Bureau of Public Roads, *A Highway Planning Study for the St. Louis Metropolitan Area*, I & II (1959), 940 p.

21. Munse and McLoone, op. cit., pp. 22-24.

22. U.S. Bureau of the Census, U.S. Census of Governments: 1962, Assessed Values for Property Taxation, Report No. 5 (Washington, 1962), pp. 15, 31, 32, 42, 43.

23. Taxable Property Values in the United States, op. cit., pp. 7, 23, 25, 132, 134.

24. U.S. Bureau of the Census, "Legal Form of Organization," U.S. Census of Business: 1958, Retail Trade Summary Statistics, I, sec. 5 (Washington, 1961), pp. 2, 28, 42; U.S. Bureau of the Census, "Type of Organization," U.S. Census of Manufactures: 1958, Summary Statistics, I, Pt. 3 (Washington, 1961), p. 3.

25. U.S. Treasury Dept., Internal Revenue Service, Statistics of Income, 1960: Individual Income Tax Returns, No. 79; U.S. Business Tax Returns, No. 453; Corporation Income Tax Returns, No. 159 (Washington, 1962).

Chapter IV

1. U.S. Office of Education, Preliminary Statistics of State School Systems 1959-60, OE-20006-60 Circular No. 663 (Washington, 1961), Table 5, p. 10.

2. U.S. Bureau of the Census, Detail of State Tax Collection in 1961, G-SF61-No. 4 (Washington, 1961), Tables 1 and 2, pp. 3-28.

3. U.S. Bureau of the Census, Summary of State Government Finances in 1960, G-SF6-No. 1 (Washington, 1961), Table 5, p. 13.

4. Thomas H. Sanders, Effects of Taxation on Executives, (Boston: Division of Research, Graduate School of Business Administration, Harvard University, 1951), chaps i, iii, v.

5. Groves and Knight, op. cit., p. 112, and Table 2, p. 115.

6. Milton C. Taylor, "The Personal Income Tax," Michigan Tax Study, Staff Papers (Lansing, 1958), p. 492.

7. U.S. Bureau of the Census, Detail of State Tax Collection in 1961, G-SF61-No. 4 (Washington, 1961), Tables 1 and 2, p. 16.

8. Munse and McLoone, op. cit., p. 155.

9. One Hundred Eleventh Report of the Public Schools of the State of Missouri, School year ending June 30, 1960 (Jefferson City, Mo., 1961), Pt. VI, pp. 113-126.

10. U.S. Bureau of the Census, General Social and Economic Characteristics, Missouri, Final Report PC(1)-27C (Washington, 1962) Tables 72 and 82, pp. 222, 269.

11. Ibid.

12. Ibid., Tables 76 and 86, pp. 242, 309.

13. Ibid. The Census reports the mean income of all income earners, but not mean family income.

14. Average family size was derived by subtracting the number of unrelated individuals from total population and then dividing this residual by the total number of families, ibid., Tables 72 and 82.

15. St. Louis Post-Dispatch, July 1, 1962.

16. Business Week, June 30, 1962, p. 152.

17. State Department of Education, The Public School Laws of Missouri, Publication No. 10 (Jefferson City, Mo., 1960), p. 18.

18. Munse and McLoone, op. cit., pp. 154-155.

Chapter V

1. U.S. Bureau of the Census, Summary of State Government Finances in 1960, G-SF6-No. 1 (Washington, 1961) Table 1, pp. 8 and 9; Detail of State Tax Collections in 1961, G-SF61-No. 4 (Washington, 1961), Table 1, p. 3.

2. John F. Due, Sales Taxation (Urbana: University of Illinois Press, 1957), pp. 12-16.

3. St. Louis Post-Dispatch, Feb. 19, 1962.

4. Business Week, Nov. 4, 1961, pp. 47 and 48.

5. Groves and Knight, op. cit., p. 85 and Table 9, p. 87; Musgrave and Daicoff, op. cit., p. 117.

6. Denzel C. Cline, "Tobacco and Alcoholic Beverage Taxation," Michigan Tax Study, Staff Papers (Lansing, Michigan, 1958), p. 431.

7. Harold M. Groves, Financing Government (New York: Henry Holt & Co., 1954), p. 251.

8. U.S. Bureau of the Census, Detail of State Tax Collections in 1961, pp. 3, 9, 10, 15, 16.

9. Groves and Knight, op. cit., p. 87.

10. Due, op. cit., p. 311.

11. St. Louis Post-Dispatch, March 10, 1962.

12. Musgrave and Daicoff, op. cit., p. 171.

13. Groves and Knight, op. cit., p. 44.

14. Musgrave and Daicoff estimated that 37.76 per cent of Michigan firms dominate their respective markets, op. cit., p. 172.

15. Ibid., Table 5, p. 138.

16. U.S. Bureau of the Census, U.S. Census of Population: 1960, General Social and Economic Characteristics, U.S. Summary, Final Report PC(1)-1C (Washington, 1962), Table 99, p. 232; Internal Revenue Service, Statistics of Income, Individual Income Tax Returns for 1959, Tables 1, 3; Federal Income Tax Forms for 1961, Tax Returns Form 1040 Instructions, p. 9.

17. Internal Revenue Service, Individual Income Tax Returns for 1959, Tables 1, 3.

18. An alternative method of evaluating spillovers is to assume that any revenue apportioned by the state to a local unit is primarily composed of funds which the local unit paid into the state education revenue fund, and that only the difference between the amount the unit paid in and the amount returned is a cost spillover. This approach fails to recognize that jurisdictions jointly agree upon the pattern of revenue apportionment, and also that interdependence results from economic interaction and tax shifting between jurisdictions.

19. Musgrave and Daicoff, op. cit., p. 137.

Chapter VI

1. Although imputation of foregone student earnings appears reasonable for a small school district in a world of full employment, such imputation may appear unreasonable when applied to the economy as a whole if job opportunities are not available for high school drop-outs. In order to distinguish between the cost from the failure of government to maintain full employment through appropriate monetary and fiscal policy, and the resource cost of providing additional education, this study

assumes a fully employed labor force. For an opposite view, see Jesse Burkhead, Public School Finance: Economics and Politics (Syracuse, N.Y.: Syracuse University Press, 1964), p. 5, and John Vaizey, The Economics of Education (London: Faber and Faber, 1962), pp. 40-46.

2. Real estate salesmen, lawyers or insurance men, however, secure prestige and hence add to their private income by virtue of school board membership. In some parts of the country, school board membership is a stepping stone to political careers. In such instances, a benefit should also be imputed for these activities.

3. In passing, reference will be made to the state sales tax-exempt status of the expenditures of public education institutions. Tax exemptions enable the educational sector of the economy to engage a volume of resources for which other sectors must pay an additional amount for the same volume of productive factors. For example, exemption of public schools from a state 3 per cent retail sales tax enables the public education sector to command resources for $100 million for which other sectors of the economy must pay $103 million. This advantage, however, only applies to those public education expenditures that would be taxable if made by private firms. Services which comprise the major portion of public school current expenditure are generally tax exempt, irrespective of their purchase by private or public institutions. Care must again be exercised to avoid double counting. If a cost was imputed to public education for municipal or other government services, which was partly financed by sales tax revenue, only a portion of the sales tax-exempt status should be imputed as a cost of public education.

4. Jacob Mincer, "On-the-Job Training: Cost, Returns, and Some Implications," Journal of Political Economy, Supplement, LXX (Oct., 1962), p. 54.

5. The U.S. Bureau of the Census in U.S. Census of Population: 1960, Detailed Characteristics—Missouri, Final Report PC(1)-27D (Washington, 1962), Table 115, p. 428, reports that 8.8 per cent of the 14-19 year old male and 5.7 per cent of the female youths in the St. Louis civilian labor force in 1960 were unemployed; 10.0 per cent of the 16-17 year old male and 8.6 per cent of the female youths actively seeking employment were unemployed.

6. Arnold Katz, "The Employment of Students," Special Labor Force Reports No. 6, Monthly Labor Review, LXXXIII (July, 1960), Table I. Of those 18-24 years old, 39.8 per cent were employed, working an average of 25.7 hours per week.

7. U.S. Bureau of the Census, Detailed Characteristics—Missouri, Table 117, p. 439, reports that 14.9 per cent of all enrolled white students between the ages of 14-17 were employed; 61.3 per cent of them worked 1-14 hours, 31.5 per cent 15-34 hours, and 7.2 per cent 35 or more hours per week; 22.8 per cent of those between ages 16-17 were employed—27.3 per cent of the male and 18.1 per cent of the female students; 56.2 per cent of the 16-17 year olds worked 1-14 hours, 36.3 per cent 15-34 hours, and 7.5 per cent 35 or more hours per week.

8. Office of the Superintendent, Clayton Public Schools, Oct. 24, 1962, and Ninth Annual Report, St. Louis County Public Schools, p. 31.

9. Division of Employment Security, Missouri State Employment Service, "Wage Rates for Typical Occupations in Manufacturing Industries," unpublished statistical tabulation, 24-1 (St. Louis, Sept., 1962).

10. Katz, loc. cit.

11. Ford Foundation Program Study, School and Community Work Related Program, Central High School, unpublished, St. Louis, Mo., Oct. 24, 1962.

12. Theodore W. Schultz, "Education and Economic Growth," *Social Forces Influencing American Education*, ed. Nelson B. Henry (Chicago: University of Chicago Press, 1961), Table 3, p. 62.

13. Wilbur Smith and Associates, in cooperation with the U.S. Bureau of Public Roads, *A Highway Planning Study for the St. Louis Metropolitan* Area, I & II (1959), 940 p.

14. The U.S. Bureau of the Census reports in *Missouri General Social and Economic Characteristics, 1960*, Table 73, p. 227, that in Clayton, the total number of kindergarten, elementary and high school students in 1960 was 2413, of which 1521 were enrolled in public schools. Since the latter enrollment was approximately 63.033 per cent of the total enrollment in Clayton, the number of school trips, 74,077, was reduced 63.033 per cent, to 46, 693 trips. The proportion of the total trips which were public school-oriented is then approximately 1.885 per cent. The cost of Clayton streets which is public school-oriented is estimated as $3,308 = (.01885 x $175,502).

15. Segelhorst, *op*. *cit*., pp. 35 and 26. Serious crimes were weighted twice as heavily as minor ones. The proportion of public school-oriented cost (.01684) was applied to total 1959-60 police costs of $205,621, excluding $9,465 of crossing guards costs which were allocated directly to the Clayton School District. The estimated cost of Clayton police services rendered to the school district is:
(.01684 x $205,620.59) + $9,455 = $12,918.

16. *Ibid*. The estimated amount for 1959-60 was determined by assuming that the ratio of school-oriented costs to total costs was the same as in 1955, i.e., 23.656 per cent. City park and recreation department costs in the fiscal year 1959-60 were $118,065.03. Thus the amount

allocated to the Clayton School District was: ($116,065.03) x (.23696) = $27,509.46.

17. The portion of costs attributable to educational demand was estimated by determining first the portion of the population in public school, i.e., 10 per cent for Clayton. It was assumed that 50 per cent of a child's public library use is school-oriented. Therefore, 5 per cent of Clayton library expenditures were attributed to the Clayton School District ($55,030.11) x (.05) = $2,750.

18. Based on the 1963 study by Engelhardt, loc. cit., in which Clayton municipal fire department services were allocated to the Clayton School District on the basis of a study of the man and equipment hours incurred in relation to fire fighting, or fire inspection of school property. The estimate certainly understates the real cost of this service for reasons cited.

19. John V. Krutilla and Otto Eckstein, Multiple Purpose River Development: Studies in Applied Economic Analysis (Baltimore: Johns Hopkins Press, 1958), Chapter IV; Roland McKean, Efficiency in Government Through Systems Analysis (New York: John Wiley and Sons, 1958), pp. 116-122; Bureau of the Budget, Standards and Criteria for Formulating and Evaluating Federal Water Resources Development (Washington, D.C., 1961), p. 71; and Stephen A. Marglin, "The Social Rate of Discount and the Optimal Rate of Investment," Quarterly Journal of Economics, LXXVII (Feb., 1963), pp. 95-111.

20. Elmer C. Deering, "Interest Rates on School Bonds: Recent Trends," School Life (Nov.-Dec., 1961), pp. 10-13.

21. Ninth Annual Report of the St. Louis County, Mo., Public Schools p. 53.

22. The City of Clayton, Missouri, *Annual Budget for the Fiscal Year 1962-63*; U.S. Bureau of the Census, *Compendium of City Government Finances in 1960* (Washington, 1961), Table 5, p. 27.

23. *Annual Report of the Comptroller of the City of St. Louis, for the Fiscal Year Ending March 31, 1962.*

Chapter VII

1. U.S. Bureau of the Census, *United States Census of Governments: 1957, Finances of School Districts*, III, No. 1 (Washington, 1959), p. 9.

2. These relationships may be stated algebraically.

$$(1)\ V_t = \sum_{i=1}^{n} (H_i\, RL_{it}/AL_{it})$$

where

V_t = Value of a facility at time t

H_i = Historical expenditure on component i of a facility adjusted for price-quality changes

RL_{it} = Remaining useful life of component i

AL_{it} = Assumed or estimated total useful life of component i

$$(2)\ RL_{Ft} = \frac{\sum_{i=1}^{n} (H_i\, RL_{it}^2/AL_{it})}{\sum_{i=1}^{n} (H_i\, RL_{it}/AL_{it})}$$

RL_{Ft} = Remaining useful life of an entire facility at time t

(3)

$$CCC_t = \frac{V_t}{\overline{UL_t}} = \frac{\left[\sum_{i=1}^{n} (R_i\, UL_i / EL_i)\right]}{\sum_{i=1}^{n} (R_i\, UL_i^2 / EL_i)}$$

CCC_t = Capital consumption cost of a facility at time t

3. Otto Eckstein, *Water-Resource Development: The Economics of Project Evaluation* (Cambridge: Harvard University Press, 1958), pp. 94-104.

4. Elmer C. Deering, "Interest Rates on School Bonds: Recent Trends," *School Life* (Nov.-Dec., 1961), pp. 10-13.

5. Roger A. Freeman, *School Needs in the Decade Ahead* (Washington, D.C.: The Institute for Social Science Research, 1958), p. 126.

6. Estimated from U.S. Office of Education, *Statistics of State School Systems*, 1957-58 (Washington, 1961), p. 60, Biennial Survey of Education in the United States.

7. *Ninth Annual Report, St. Louis County Public Schools*, p. 56.

8. U.S. Office of Education, *loc. cit.*

9. Building information specially compiled by the Clayton, Missouri School District.

10. Department of Labor, *Construction Volume and Costs, 1915-56*, A Statistical Supplement to Construction Review, p. 54.

11. Chap. ii, Table 2.

12. *Supra.*, chap. iii, Table 9.

13. Robert Wade, "Assets of Private Non-Profit Institutions in the United States," unpublished MS, New York, National Bureau of Economic Research, April, 1954.

14. Chap. iii, Table 11.

15. Chap. iv, Table 23, and chap. v, Tables 24, 25 and 26.

Chapter VIII

1. The indicated change is analyzed within the framework of comparative statics. The transitional costs (or benefits) of the indicated change are not included. For example, the additional cost of providing education for 13, rather than 12, classes for 12 years before the conversion is completed, is not included.

2. For an analysis of the effect of industrialization upon the costs and revenues of a school district, see Werner Z. Hirsch, "Fiscal Impact of Industrialization on Local Schools," *Review of Economics and Statistics*, XLVI, No. 2, May, 1964, pp. 191-199.

Chapter IX

1. Kenneth E. Boulding, *Economic Analysis* (third edition; New York: Harper and Brothers, 1955), chap. xx, "Dynamic Macro-Economic Models," pp. 426-33. For a discussion of the demographic problems related to this issue, see for example, Donald J. Bogue, "Internal Migration," *The Study of Population: An Inventory and Appraisal*, edited by Philip M. Hauser and Otis Dudley Duncan (Chicago: University of Chicago Press, 1959), pp. 486-509; Amos H. Hawley, *Human Ecology: A Theory of Community Structure* (New York: The Ronald Press Co., 1950), p. 327; and Walter Isard, *Methods of Regional Analysis: An Introduction to Regional Science* (New York: Technology Press of Massachusetts Institute of Technology and John Wiley & Sons, Inc., 1960), chap. iii, "Migration Estimation," pp. 68-69.

Chapter I

1. This view admittedly places heavy emphasis on the investment aspects of education.

2. Gary S. Becker, "Underinvestment in College Education," American Economic Review, Proceedings, L (May, 1960), pp. 346-54; H.S. Houthakker, "Education and Income," Review of Economics and Statistics, XLI (Feb., 1959), pp. 24-28; Herman P. Miller, "Annual and Lifetime Income in Relation to Education," American Economic Review, L (Dec., 1960), pp. 962-986; Edward F. Renshaw, "Estimating the Returns to Education," Review of Economics and Statistics, XLII (Aug., 1960), pp. 318-324; W. Lee Hansen, "Total and Private Rates of Return on Investment in Schooling," Journal of Political Economy, LXXI (April, 1963), pp. 128-40.

3. Burton A. Weisbrod, External Benefits of Public Education (Princeton: Industrial Relations Section, Princeton University, 1964), 144 p.

4. Edward F. Denison, The Sources of Economic Growth in the United States and the Alternatives Before Us, *Supplementary Paper No. 13* (New York: Committee for Economic Development, Jan., 1962), pp. 69-70.

5. Weisbrod, op. cit., pp. 10-13.

6. These data have some shortcomings. For example, those in the higher income brackets benefit substantially from interest, rent and dividends. A further depreciation arises because of personal reasons that often affect responses of those interviewed; individuals may knowingly or unwittingly under- or over-state their true monetary income.

7. Gary S. Becker, The Economics of Discrimination (Chicago: University of Chicago Press, 1957), 137 p.

8. Werner Z. Hirsch, "Determinants of Public Education Expenditures," *National Tax Journal*, XIII, No. 1 (March, 1960), pp. 29-40.

9. J. N. Morgan, *et al.*, *Income and Welfare in the United States* (New York: McGraw Hill, 1962), p. 51.

10. The net effect of migration probably varies between individuals of differing race, occupation, work experiences, and other factors, some of which are included as variables in the analysis.

11. Dael Wolfle and Joseph G. Smith, "The Occupational Value of Education for Superior High School Graduates," *The Journal of Higher Education*, XXVII, No. 4 (April, 1956), pp. 201-212.

12. For examples of this type of analysis and a mathematical interpretation of it, see Daniel Suits, "Use of Dummy Variables in Regression Equations," *Journal of the American Statistical Association*, LII (Dec., 1957), pp. 548-551; T. P. Hill, "An Analysis of the Distribution of Wages and Salaries in Great Britain," *Econometrica*, XXVII (July, 1959), pp. 355-81; Morgan *et al.*, *op. cit.*, chaps. iii-v, pp. 25-85, used this type of analysis in their study of income and welfare in the United States.

13. When a variable assumed only one of two characteristics, it was unnecessary to form a dummy variable, and values of 1 and -1 were arbitrarily assigned. When the variable had three or more possible characteristics, the number of dummy variables is one less than the number of possible characteristics.

14. *The Sample Survey of Citizen Participation in Local Government: Method and Procedures* (mimeographed), prepared under the direction of Scott A. Greer, Chief Sociologist and Assistant Research Director, Metropolitan St. Louis Survey, St. Louis, Missouri, Aug. 7, 1957.

15. U.S. Bureau of the Census, Historical Statistics of the United States, Colonial Times to 1957 (Washington, 1960), Series H234-245, "Average Annual Salary Instructional Staff: 1870 to 1956," p. 208, and Series E13-24, "Wholesale Price Index, Bureau of Labor Statistics, All Commodities Other than Farm and Food," pp. 116-17.

16. Since very few respondents had been in school less than five years (the average for persons with less than an eighth-grade education was 5.6 years), the income benefit from primary education was assumed to reflect merely the last 2.4 years. The average net annual incremental income of an additional year of elementary and secondary education was computed by weighting by 8 the average annual increment resulting from elementary education, that of high school by 4, and by dividing the sum by 12. Should benefits of primary education cumulate and be realized only after a certain minimum education level is achieved, we might overstate the benefits. However, this procedure accounts for ability differences between persons of equal age with or without an eighth-grade education.

17. It has been argued that discounting may be unnecessary because "in a growing economy every individual may expect an upward trend in his own earnings superimposed on the cross-sectional pattern for a particular year" (Houthakker, op. cit., p. 27). Our cross-section data compare current income of individuals with their education in different historical periods. We assume that incremental earnings differences which are the result of past historical trend will be maintained in the future. If individual productivity increases with age because the latent effect of formal education permits one to learn from experience, our method of summing the mean annual earnings differential over an individual's

entire lifetime results in a slight overestimate of present value. Early working-year earnings increments are overvalued by the discounting procedure more than the present value of later year earnings increments are undervalued.

18. John V. Krutilla and Otto Eckstein, Multiple Purpose River Development: Studies in Applied Economic Analysis (Baltimore: John Hopkins Press, 1958), Chapter IV; Roland McKean, Efficiency in Government Through Systems Analysis (New York: John Wiley and Sons, 1958), pp. 116-122; Bureau of the Budget, Standards and Criteria for Formulating and Evaluating Federal Water Resources Development (Washington, 1961), p. 71; and Stephen A. Marglin, "The Social Rate of Discount and the Optimal Rate of Investment," Quarterly Journal of Economics, LXXVII (Feb., 1963), pp. 95-111.

19. U.S. Bureau of the Census, U.S. Census of Population: 1960. Final Report PC(2)-5B, Subject Reports—Educational Attainment, Table 7 (Washington, 1963).

20. These estimates are individualistic in that they do not express the increase in a female's real income derived from the opportunity education gives her to marry a male with higher earning capabilities. Nor do these findings reflect the income effects of the educated mother upon her children. The many non-market benefits of education for women are in no way denied by their exclusion in this chapter.

21. Edward F. Denison, "Education, Economic Growth, and Gaps in Information," The Journal of Political Economy (October, 1962), LXX Supplement, No. 5, p. 124.

22. Herman P. Miller, op. cit., Table 11, p. 981. Miller's estimate, like ours, is based on persons reporting income, and

therefore excludes totally unemployed individuals with no income. Both estimates, however, include partially unemployed individuals.

23. George A. Bishop, "The Tax Burden By Income Class, 1958," National Tax Journal, XIV, No. 1 (March 1961), Table VI, p. 54; and Herman P. Miller, "Annual and Lifetime Income in Relation to Education," American Economic Review, Vol. L (December, 1960), pp. 962-86.

Chapter XI

1. Since most working mothers have full-time jobs, we shall not consider the possibility of part-time employment. In March 1956, of the more than five million mothers in the nation's labor force with children under 17 years of age, over two-thirds (3.7 million) worked either full-time or 35-39 hours a week. U.S. Bureau of the Census, Marital and Family Status of Workers: 1956, Current Population Report, P-50, No. 73 (Washington, 1957), Table E, p. 3.

2. Herman P. Miller has noted that the final estimate of net private income (Line 6) is severely reduced by assuming the mother works only part of the year. He indicates that once the decision to go to work is made, the mother is likely to continue to work during the summer months. Under Miller's formulation the mother's net private income (Line 6) would be close to $[illegible].

3. This method of calculating childcare benefits looks at the benefits of public education as the alternative cost of providing public education privately in the market; output is not measured directly but in terms of input costs.

4. U.S. Bureau of Labor Statistics, *Marital and Family Characteristics of Workers, March 1960*, Special Report No. 13, *Monthly Labor Review*, April, 1961, Table G. p. A-13, and Table I, p. A-14.

5. U.S. Bureau of the Census, *County and City Data Book*, Items 34, 36, and 37 (Washington, 1962); and *U.S. Census of Population: 1960, Missouri, General Social and Economic Characteristics*, PC(1)-27C, Final Report, Table 73, p. 227.

Chapter XII

1. Edward F. Denison, *The Sources of Economic Growth in the United States and the Alternatives Before Us*, Supplementary Paper No. 13 (New York: Committee for Economic Development, Jan., 1962), italics added.

2. Cf. Fritz Machlup, *The Production and Distribution of Knowledge in the United States* (Princeton: Princeton University Press, 1962), p. 57.

3. Gary S. Becker, "Investment in Human Capital: A Theoretical Analysis," and Jacob Mincer, "On-The-Job Training: Costs, Returns, and Some Implications," *Journal of Political Economy*, LXX, Supplement (Oct. 1962), pp. 9-79.

4. Mincer, *ibid.*, Table 11, p. 77.

5. Mincer, *ibid.*, Table A7, p. 78.

6. However, because of their improved income, wealth, social position and different tastes, educated persons are likely to have more property that needs protection against fire and theft; more cars that require highways and traffic control; cultural desires calling for more

and better museums, symphony orchestras, parks, etc. All this can lead to increases in the need for public services and tax revenue and in cancellation of the otherwise reduced requirements.

7. Burton A. Weisbrod, External Benefits of Public Education (Princeton: Industrial Relations Section, Princeton University, 1964), pp. 80-94.

8. U.S. Bureau of the Census, County and City Data Book, 1962 (Washington, 1962), Table I, p. 3; and U.S. Census of Population: 1960—Missouri, General Social and Economic Characteristics, Table 81, p. 236.

9. Social service expenditures may rise if the in-migrant has a lower educational attainment than the community average. However, expenditures will not have to rise as much as they would had the in-migrant not received the additional education.

10. Theodore W. Schultz, "Education and Economic Growth," Social Forces Influencing American Education (Chicago: National Society for the Study of Education, 1961), pp. 74-77.

11. U.S. Bureau of the Census, Current Population Reports, Population Reports, Population Characteristics, Series P-20, No. 110 Washington, July 1961), Table 10, p. 15.

12. Machlup, op. cit., p. 56.

13. Burton A. Weisbrod, "Education and Investment in Human Capital," The Journal of Political Economy, LXX Supplement (Oct. 1962), p. 110.

Chapter XV

1. For bibliographic guides to the literature on decision making and decision making models, see William J. Gore and Fred S. Silander, "A Bibliographical Essay on Decision Making," Administrative Science Quarterly, IV (June, 1959), 98-121; also Lawrence J.R. Herson, "In the Footsteps of Community Power," American Political Science Review (Dec., 1961), 817-830.

2. See, for example, Daniel P. Moynihan, "How Catholics Feel About Federal School Aid," The Reporter, XXIV (May 25, 1961), p. 36.

3. We are indebted to Harold M. Groves and Roland N. McKean for raising several questions regarding our analytical framework.

4. Recent efforts to clarify the various aid programs include Paul R. Mort, Walter C. Reusser, and John W. Polley, Public School Finance (New York: McGraw-Hill Book Co., Inc., 1960), chap xv; Roe L. Johns and Edgar L. Morphet, Financing the Public Schools (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1960), chap xii.

5. Harold M. Groves has expressed his "profound distrust" of these measures in correspondence with the senior author.

6. One effort in this direction is Werner Z. Hirsch, "Quality of Government Services," Public Expenditure Decisions in the Urban Community, Schaller, ed. (Washington, D.C.: Resources for the Future, Inc., 1963), pp. 163-179.

7. Likewise, there is growing awareness of the school district's responsibility to its community's development programs, cf. Richard C. Lonsdale, The School's Role in Metropolitan Development (Syracuse University Press, 1960), 51-60.

8. Werner Z. Hirsch, "Fiscal Impact of Industrialization on Local Schools," Review of Economics and Statistics (May, 1964), pp. 191-199.

9. This general principle is incorporated in California Assembly Bill No. 49, introduced on February 5, 1964, to the First Extraordinary Session of the 1964 Legislature by Assemblyman John L. E. Collier, in relation to higher education.

10. For a pertinent summary of grants-in-aid see Kjeld Philip, Intergovernmental Fiscal Relations (Copenhagen: Institute of Economics and History, University of Copenhagen, 1954), pp. 92-103.

11. The burden upon a district (1) will tend to change depending upon the difference between the burden upon (1) of federal funds awarded to (1) and the burden upon (1) of an equal amount of funds raised by the state, and the difference between the burden upon (1) of federal funds given to the other districts, i.e. (2), and that of an equal amount of funds raised by the state to finance districts (2).

12. In this case the difference between the burden upon district (1) of federal or state funds awarded to (1) and that upon (1) of an equal amount of funds raised locally and the difference between the burden upon (1) of federal or local funds given to (2) and that upon (1) of an equal amount of funds raised by school districts(2) must be estimated.

13. It should be noted that the stimulation effect of most present grants appears to be extremely low. See Edward F. Renshaw, "A Note on the Expenditure Effect of State Aid to Education," LXVIII, Journal of Political Economy (April, 1960), 170-74.

14. For a description and partial analysis of these laws see I. M. Labovitz, Aid for Federally Affected Public Schools (Syracuse: Syracuse University Press, 1963), 205 p.

15. Werner Z. Hirsch, "Administrative and Fiscal Considerations in Urban Government," *The Annals of the American Academy of Political and Social Science*, CCCLII (March, 1964), pp. 48-61.

16. Burton A. Weisbrod, *External Benefits of Public Education* (Princeton: Industrial Relations Section, Princeton University, 1964), pp. 6-7.

17. *Ibid.*

18. *Ibid.*, p. 7. In chap. ix Weisbrod presents some empirical findings which are interpreted to mean that migrants are affected by education expenditures.

19. We owe this point to Richard A. Musgrave, made by him in a written communication to the senior author.

20. See, for example, James A. Maxwell, *Intergovernmental Tax Credits* (Washington: The Brookings Institution, 1962).

Appendix

1. U.S. Public Health Service, records (for live births), and *Vital Statistics of the United States, 1959*, Vol. II, (for deaths), as reported *in U.S. Bureau of the Census, County and City Data Book, 1962*, *op. cit.*, Items 18-19.

2. Norma L. Lucas, "Pupil Mobility Information Compiled in the Department of Special Education for the Board of Education Meeting, October 15, 1962" (Clayton Public School District, October 15, 1962).

3. U.S. Bureau of the Census, *United States Census of Population, 1960: General Social and Economic Characteristics—Missouri*, *op. cit.*, Table 72, p. 222.

4. *Ibid.*, and *Annual Report of St. Louis County Public Schools*, 1959-60, p. 37.

5. U.S. Bureau of the Census, *U.S. Censuses of Population and Housing, 1960, Census Tracts: St. Louis, Missouri—Illinois Standard Metropolitan Statistical Area*, Final Report PHC (1)-131 (Washington: USGPO, 1962), p. 15.

6. *Ibid.*

7. U.S. Bureau of the Census, *United States Census of Population, 1960: General Social and Economic Characteristics—Missouri*, p. 209.

8. U.S. Bureau of the Census, *Census Tracts: St. Louis, Mo.—Ill., Standard Metropolitan Statistical Area.*

9. U.S. Bureau of the Census, *County and City Data Book, 1962* (Washington, 1962), p. 473.

10. U.S. Bureau of the Census, *Census Tracts: St. Louis, Mo.—Ill.*

11. *Ibid.*

12. *Ibid.*

13. *Ibid.*

14. U.S. Bureau of the Census, *County and City Data Book, 1962.*

15. *Ibid.*, p. 449.

16. U.S. Bureau of the Census, *General Social and Economic Characteristics—Missouri, 1960*, Table 42, p. 189.

17. U.S. Bureau of the Census, *County and City Data Book, 1962*, Item 33, p. 3.

18. T. N. E. Greville, *Illustrative United States Population Projections*, Actuarial Study No. 46, U.S. Department of Health, Education and Welfare, Social Security Administration, Division of the Actuary

(Washington: USGPO, May, 1957), pp. 22-42.

17. U.S. Bureau of the Census, *General Social and Economic Characteristics—Missouri, 1960*, Table 43, p. 150, and Table 86, p. 268.